

**ADDITIONAL INVESTIGATIONS WORK PLAN AND QUALITY ASSURANCE
PROJECT PLAN
FOR
DOCUMENTATION OF
ENVIRONMENTAL INDICATOR DETERMINATION (CA725)
CURRENT HUMAN EXPOSURES UNDER CONTROL/**

**MacDermid, Incorporated
Waterbury, Connecticut**

RCRA RECORDS CENTER
FACILITY WATERBURY
I.D. NO. CTDOCU15950
FILE LOC. R-13
OTHER 104436

June 24, 2004

Prepared for

**MACDERMID, INCORPORATED
245 Freight Street
Waterbury, CT 06702**

Prepared by

**LOUREIRO ENGINEERING ASSOCIATES, INC.
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An Employee Owned Company

Comm. No. 91mh401

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June 24, 2004

Loureiro Engineering Associates, Inc.

United States Environmental Protection Agency, Region I

1 Congress Street

Suite 1100

Mail Code HBT

Boston, Massachusetts 02114-2023

Attn: Ms. Carolyn Casey

**RE: Additional Investigations Work Plan and QAPP
MacDermid Facility, Waterbury, CT
LEA Comm. No. 91MH401**

Dear Ms. Casey:

MacDermid, Inc. is pleased to submit this Additional Investigations Work Plan and Quality Assurance Project Plan (QAPP) in support of additional investigation efforts necessary to address the April 9, 2004 EPA Comments to the Documentation of Environmental Indicator Determination (CA725). This Work Plan has been prepared by Loureiro Engineering Associates, Inc. (LEA) at the request of MacDermid, Inc. in response to a request received from the EPA in its document "Technical Review of the Documentation of Environmental Indicator Determination (CA725) Current Human Exposures Under Control, Dated April 9, 2004." The Work Plan addresses the following:

1. The installation of groundwater monitoring wells and piezometers, as well as groundwater sampling procedures, and includes a Quality Assurance Project Plan (QAPP) for the collection of samples and management of data associated with those activities. The procedure used by LEA to enter and verify electronic analytical data is included as part of the QAPP.
2. Additional research and evaluations to address downgradient industrial water supply wells.
3. Recreator use and accessibility to the Naugatuck River.
4. Indoor air exposure assessment for off-site workers in the surrounding commercial and industrial facilities.

Should you have any questions or comments, please do not hesitate to contact me at 860-410-2968.

Sincerely,

LOUREIRO ENGINEERING ASSOCIATES, INC.


Brian Cutler, PE, LEP
Senior Vice President

Enclosures

cc Mr. Richard Nave, MacDermid, Inc.



FedEx Priority Overnight

Loureiro Engineering Associates, Inc.

TRANSMITTAL

TO: Region I, New England One Congress Street Suite 1100 (Mail Code HBT) Boston, MA 02114-2023 ATTN: Ms. Carolyn Casey	DATE 6/25/04 PROJECT MacDermid Work Plan LOCATION: Waterbury, CT COMM. NO.: 91MH401 PHONE # (617) 918-1368
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☒ Plans ☐ Prints ☐ Shop Drawings ☐ Specifications
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REMARKS:

Carolyn- Please find the attached Work Plan for the MacDermid facility located in Waterbury, CT.

Thanks

BY: Barbara Heemink

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1. INTRODUCTION

This Work Plan has been prepared by Loureiro Engineering Associates, Inc. (LEA) at the request of MacDermid, Inc. in response to a request received from the EPA in its document "Technical Review of the Documentation of Environmental Indicator Determination (CA725) Current Human Exposures Under Control, Dated April 9, 2004." The Work Plan addresses the following:

1. The installation of groundwater monitoring wells and piezometers, as well as groundwater sampling procedures, and includes a Quality Assurance Project Plan (QAPP) for the collection of samples and management of data associated with those activities. The procedure used by LEA to enter and verify electronic analytical data is included as part of the QAPP.
2. Additional research and evaluations to address the presence of downgradient industrial water supply wells.
3. Recreator use and accessibility to the Naugatuck River.
4. Indoor air exposure assessment for off-site workers in the surrounding commercial and industrial facilities.

Of the above-mentioned objectives for this Work Plan, the primary activities to be performed include monitoring well and piezometer installation and groundwater sampling. Ancillary activities, such as the advancement of boreholes, collection and possible analysis of soil samples, collection of water-level measurements, and data management from collection to presentation and archiving are also included. Descriptions of the procedures that will be followed during performance of the activities conducted under this Work Plan are described in Sections 2.0 through 4.0 of the Work Plan. All field activities and data management procedures will be performed in accordance with the QAPP for the project, which is provided in this Work Plan as Section 5.0. Sections 6.0 and 7.0 of the Work Plan address the additional evaluations regarding downgradient production wells and recreator use and accessibility to the Naugatuck River, respectively.



2. MONITORING WELL AND PIEZOMETER INSTALLATION

2.1 Monitoring Well Installation

Two locations along the western property boundary will be selected for the installation of nested groundwater monitoring wells. One location will be approximately 100 feet north of well location MW-116 and one location will be approximately 200 feet south of well location MW-116, both situated along the western property boundary. The proposed permanent nested groundwater monitoring wells are illustrated on Drawing 1. The purpose of the wells will be to provide a refined understanding of groundwater flow direction and contaminant along the western property boundary and a better understanding of contaminant concentration along the western property boundary.

One of the two wells at each location will be installed such that the screen intersects the water table. The remaining well at each location will be installed with the screened section at a depth approximately equivalent to that at well MW-116D to assess contaminant concentrations at depth within the aquifer. All groundwater monitoring wells will be installed in accordance with the LEA Standard Operating Procedure (SOP) entitled *Installing & Developing Monitoring Wells and Piezometers*.

All monitoring wells will be constructed using the Geoprobe® Pre-Pack monitoring well construction materials. The pre-pack construction consists of five-foot long sections of 1.5-inch Schedule 40 polyvinyl chloride (PVC), 0.010-inch slotted Schedule 80 PVC screen with a 1.5-inch inner diameter pre-pack filter held in place by stainless steel mesh. The pre-pack screen sections may be joined to provide screen length multiples of five feet. A 1.5-inch diameter Schedule 40 PVC riser connects the screen to the surface.

Screen lengths for the proposed monitoring wells will be 10 feet. After the screen and riser is installed, one to two feet of sand will be placed above the screen to prevent the bentonite seal from leaking downward into the screened interval. A bentonite seal will be placed from the top of the sand cap to the surface. Emplacement of the sand cap and the bentonite seal will be performed while slowly retrieving the casing, allowing the native formation material to collapse around the backfill material.

All proposed wells will be completed with a 2-foot by 2-foot by 2-foot concrete pad and flush-mount well protector. All SOPs identified in this Work Plan are provided in Appendix A.



At each of the proposed locations, monitoring wells will be installed into borings advanced in accordance with the LEA SOP entitled *Geoprobe® Probing and Sampling* (Appendix A) under the supervision of an LEA geologist. Soil samples will be collected every two feet, and an aliquot of soil from each two-foot interval will be screened in the field for volatile organic compounds with a photoionization detector (PID). At each location, the LEA geologist will prepare a field boring log documenting the visual classification of the soils encountered. Soils will be classified using a modified Burmister soil classification system in accordance with the LEA SOP entitled *Geologic Logging of Unconsolidated Sedimentary Materials* (Appendix A).

2.2 Piezometer Installation

LEA will also install piezometers at four locations on the site. These piezometers will be located in the vicinity of historic groundwater monitoring wells that have either been damaged or destroyed. Specifically, piezometers will be installed in the vicinity of the historic wells MW-104, MW-106, and MW-107. In addition, a piezometer will be installed in the general vicinity of well MW-108. The proposed piezometer locations are depicted on Drawing 1. These temporary installations will be utilized to provide water-level data supplemental to that obtained from the existing well network.

The piezometers will be installed into boreholes advanced using Geoprobe® probing and sampling techniques, as described in the LEA SOP entitled *Geoprobe® Probing and Sampling* (Appendix A). The piezometers will be constructed in a manner similar to that described above for monitoring wells using pre-packed 1½-inch diameter PVC screen and riser, with the screened interval for each piezometer set across approximately the same zone of the aquifer as that of the original monitoring wells that each piezometer is designed to replace. Each piezometer installation will be then be completed in a manner similar to that described above for the monitoring wells.

2.3 Well Development

All newly installed monitoring wells and piezometers will be developed following installation in accordance with procedures described in the LEA SOP entitled *Installing & Developing Monitoring Wells and Piezometers* (Appendix A). The monitoring wells will be developed at least one week prior to collection of groundwater samples from those wells.

2.4 Well Survey and Water-level Measurements

Following installation, each of the newly installed wells and piezometers will be surveyed for location and elevation relative to an arbitrary datum that has been established for the site. Water



levels in each of the newly installed and existing monitoring wells and the newly installed piezometers will be measured in accordance with procedures described in the LEA SOP entitled *Liquid Sample Collection and Field Analysis* (Appendix A). During this activity, LEA field personnel will also compile an inventory identifying the condition of the wells.



3. GROUNDWATER SAMPLE COLLECTION

3.1 Sample Collection and Analysis

LEA will collect a single round of groundwater samples from the viable existing monitoring wells and the newly installed monitoring wells on the site. Groundwater sampling will be conducted in general accordance with the LEA SOPs entitled *Liquid Sample Collection and Field Analysis* and *Low Flow (Low Stress) Liquid Sample Collection and Field Analysis* (Appendix A).

Depending on the condition of the monitoring wells, up to 19 wells will be sampled for volatile organic compounds (VOCs), metals (arsenic, barium, cadmium, chromium, mercury, lead, selenium, silver, copper, nickel, and zinc), and cyanide. Following collection from the monitoring well, groundwater samples will be placed into appropriate containers and preserved in accordance with specifications specific to the analyses being performed. The sampling containers will be placed into a cooler maintained at a temperature of 4° C until delivery to the state-certified laboratory that will be performing the analysis. The sample coolers will be delivered under appropriate chain-of-custody procedures to the analytical laboratory in accordance with procedures identified in the LEA SOPs entitled *Liquid Sample Collection and Field Analysis* and *Quality Assurance/Quality Control Procedures for Field Activities*.

3.2 QA/QC Procedures Associated With Groundwater Sample Collection

Quality Assurance/Quality Control (QA/QC) procedures specific to field activities and sample collection that will be performed during the course of the investigation are detailed in the SOP noted above, which is provided in Appendix A, and will include:

- A single blind replicate sample will be collected and coded in a fashion that will not alert the laboratory to the fact that it is a replicate sample.
- A trip blank will be prepared prior to initiation of sampling activities for each day on which samples intended for VOC analysis will be collected. All samples to be analyzed for VOCs will be stored in the same cooler as the trip blank each day until delivery to the analytical laboratory. Each trip blank will be subsequently analyzed for VOCs using EPA Method 8260.
- Sampling personnel will make every effort to collect the replicate samples in a manner that will ensure that the samples are as close to replicate samples as possible, given the inherent constraints associated with groundwater sampling procedures.



- Field equipment blanks will be collected by pouring distilled, deionized water through and over decontaminated sampling equipment into prelabelled sample containers, with the time of collection noted.
- Field equipment blanks will be collected at the rate of one per day.
- Chain-of-custody and field sampling reports will be logged after collection of each sample.

QA/QC procedures related to laboratory activities will be the responsibility of the laboratory and must be in accordance with established guidelines for QA/QC for laboratories certified by the State of Connecticut.



4. ASSOCIATED FIELD AND DATA MANAGEMENT ACTIVITIES

4.1 Equipment Decontamination

All sampling equipment used during the investigation will be subjected to decontamination procedures before and in-between sample collection. Decontamination of the sampling equipment will be performed according to the following procedures:

- All excess loose dirt and debris will be removed from the sampling equipment and placed in a five-gallon container appropriate for the purpose.
- Sampling equipment will then be placed in an Alconox and tap water solution and scrubbed to remove all debris.
- The sampling equipment will be rinsed twice by immersion into two tap water rinse baths.
- A spray of <10% methanol in water will be applied to the equipment and, where metals are of concern, a spray of <10% nitric acid in water will also be applied.
- A spray rinse of distilled water will then be applied to the equipment.
- Rinse and wash waters will be changed as necessary to ensure complete decontamination of sampling equipment.

4.2 Residuals Management

All soil and groundwater not directly collected into sample containers will be containerized as appropriate for the particular type of material and appropriately labeled as remediation waste in accordance with applicable state and federal regulations. All spent decontamination fluids will be placed into a closed-top five-gallon container. The container will be labeled as appropriate in the field and stored in a secure area for future disposal.

4.3 Health and Safety Plan

A site-specific Health and Safety Plan has been developed for the site. All personnel performing onsite activities related to the tasks identified in this Work Plan will be familiar with the contents of the site Health and Safety Plan before they begin work at the site, and will sign the Health and Safety Plan in accordance with company policy.



4.4 Documentation

Documentation of all field activities and procedures will be in accordance with the SOP entitled *Documentation and Integrity of Field Sampling Activities* and all other SOPs included as Appendix A. Data management documentation will be consistent with the descriptions of those activities that are presented in the *Data Management Plan* and *LEA Procedure for Entering and Verifying Electronic Analytical Data* that are provided in Appendix B. Copies of the field forms that will be used during this supplemental investigation are included in Appendix C. Following completion of all field activities and a review of the conditions observed and analytical results, a final report will be prepared. This report will document activities performed during the course of the investigation, present results of laboratory analyses, evaluate the data obtained during the investigation with regard to characterizing onsite soils, and provide recommendations for any future course(s) of action should such be necessary.



5. QUALITY ASSURANCE PROJECT PLAN

The QAPP discusses objectives and QA/QC protocols that will be used to achieve the Data Quality Objectives (DQOs) for the installation of groundwater monitoring wells and piezometers and groundwater sampling, including ancillary field and data management activities, that will be performed at the site. The field sampling plan was designed to meet the objectives of providing supplemental information on groundwater levels and groundwater quality that will support approval of a revised Documentation of Environmental Indicator Determination (CA725) Current Human Exposures Under Control .

This QAPP has been prepared with reference to the guidance presented in the Region I, EPA-New England Compendium of Quality Assurance Project Plan Requirements and Guidance document and Attachment A to this document Region I, EPA New England Quality Assurance Project Plan Manual (QAPP Manual). The Quality Assurance/Quality Control procedures that will followed during this project have been described in detail for each of the field activities in the LEA SOPs identified in the previous sections of this Work Plan. They include the Standard Operating Procedures for:

- *Installing & Developing Monitoring Wells and Piezometers*
- *Geoprobe® Probing and Sampling*
- *Geologic Logging of Unconsolidated Sedimentary Materials*
- *Liquid Sample Collection and Field Analysis*
- *Low Flow (Low Stress) Liquid Sample Collection and Field Analysis*
- *Quality Assurance/Quality Control Procedures for Field Activities*
- *Documentation and Integrity of Field Sampling Activities*

In addition to those SOPs, all of which are provided in Appendix A, activities associated with data management during and following collection are described in detail in the two documents entitled *Data Management Plan* and *LEA Procedure for Entering and Verifying Electronic Analytical Data*. These documents are included with this Work Plan in Appendix B.



5.1 Objectives of the Quality Assurance Project Plan

Quality assurance objectives are generally defined in terms of Data Quality Indicators (DQIs). DQIs are comprised of five parameters: precision, accuracy, representativeness, completeness, and comparability (PARCCs parameters).

The objective of this QAPP is to present the QA/QC procedures to be implemented during the supplemental investigation activities described in previous sections of the Work Plan. The QAPP ensures that the data generated is of sufficient quality and quantity to allow confirmation that the investigation objectives for the site are achieved. The sampling objectives of the proposed investigation are to:

- Collect sufficient data to address the continued EPA concern that contaminated groundwater present at the site migrates in the direction of residential properties located west of the site.
- Provide a refined understanding of groundwater flow direction and contaminant distribution along the western property boundary.

Preliminary DQOs were identified to ensure that the data generated during field sampling will be of adequate quality and sufficient quantity to form a sound basis for decision making purposes relative to the above objectives. DQOs have been specified for the proposed investigation relative to the following items:

- Data Uses;
- Data Types;
- Data Quality;
- Data Quantity;
- Sampling and Analytical Methods; and
- Data Precision, Accuracy, Representativeness, Completeness, and Comparability Parameters (DQIs).



6. EVALUATION OF DOWNGRADIENT PRODUCTION WELL USE

LEA will perform additional research and evaluations to address recreator use and accessibility to the Naugatuck River. A well survey performed by LEA resulted in the identification of down gradient industrial water supply wells. To supplement this survey, additional tasks will be completed to clarify whether the production wells are still in use. If the production wells are in use, an appropriate inquiry will be performed, without contacting the well owner, to identify if any chemical parameter testing has been performed. In addition, if wells are found to be in use, groundwater contamination at the site will be evaluated with respect to whether or not a potential for risk to downgradient users exists as a result of groundwater quality on or potentially emanating from the site.



7. EVALUATION OF ACCESSIBILITY TO THE NAUGATUCK RIVER

Further evaluation will be performed to address inaccessibility of the Naugatuck River to recreators. A literature search and contact with the local public health department will be completed. The results of these activities will be documented and a complete characterization of the use of the Naugatuck River in the vicinity of the site will be provided. If the Naugatuck River is determined to be used by recreators and represents a complete pathway, LEA will perform an appropriate evaluation to assess the significance of the pathway. Additional data are necessary to support the evaluation. An additional proposal will be provided for appropriate level of investigation to support that groundwater contamination present at the site does not pose a perceptible impact to surface water or sediment quality in the Naugatuck River.



8. OFFSITE COMMERCIAL/INDUSTRIAL INDOOR AIR ASSESSMENT

Utilizing the existing and newly acquired information, the potential for off-site workers in the surrounding commercial and industrial facilities to be exposed to indoor air contamination will be assessed. Based on information obtained during the proposed investigation and previously existing data, modeling of potential risk to receptors due to contamination of indoor air from groundwater at the site will be modeled using the most appropriate version of the Johnson and Ettinger model and associated spreadsheets. The evaluation will be conducted in accordance with the November 2002 OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance) using the tiered evaluation process included in that guidance document.



FIGURES

**US EPA New England
RCRA Document Management System
Image Target Sheet**

RDMS Document ID # 104436

Facility Name: MacDermid Inc

Facility ID#: CTD001164599

Phase Classification: R-13

Purpose of Target Sheet:

☒ **Oversized (in Site File)** ☐ **Oversized (in Map Drawer)**

☐ **Page(s) Missing** (Please Specify Below)

☐ **Potential FOIA Exempt** ☐ **Other** (Please Provide Purpose Below)

Description of Oversized Material, if applicable:

Figure 1: Proposed Monitoring Well & Piezometer Locations
6/24/2004

☒ **Map** ☐ **Photograph** ☐ **Other** (Please Specify Below)

APPENDIX A

LEA STANDARD OPERATING PROCEDURES

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installing and Developing Monitoring Wells and Piezometers

SOP ID: 10007
Date Initiated: 02/20/90
Revision No. 006: 08/12/02

Approved By: <u>/s/ Joseph T. Trzaski</u>	<u>08/12/02</u>
Joseph T. Trzaski	Date
Senior Scientist	
 <u>/s/ Nick D. Skoularikis</u>	 <u>08/12/02</u>
Nick D. Skoularikis	Date
Director of Quality	

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	02/20/90	
001-004	-	No record.
005	12/31/01	Formatting and minor revisions throughout.
006	08/12/02	Added section on utility clearance.



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Installing and Developing
Monitoring Wells and Piezometers

1. Purpose and Scope

This standard operating procedure (SOP) is designed to describe the methods and procedures used to install and develop monitoring wells and piezometers in a water-table aquifer. Monitoring well and piezometer installation and development shall generally follow the guidelines presented in the *"Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells"* (United States Environmental Protection Agency (EPA), 1989), the *"RCRA Ground Water Monitoring Technical Enforcement Guidance Document"* (EPA, 1986), and any state or local guidance, or regulatory documents which are available.

This SOP describes general procedures and guidelines to be followed or consulted for the proper methods to be used when installing monitoring wells or piezometers in unconsolidated deposits and bedrock. Because each site is unique and the purpose of the monitoring wells may vary from installation to installation, no definitive rules can be established. Throughout this SOP reference to monitoring wells is also intended to mean piezometers unless specifically indicated otherwise. This SOP also applies to monitoring wells and piezometers installed by Geoprobe® direct push technologies.

2. Definitions

None

3. Equipment and Decontamination

3.1. Equipment Supplied by the Drilling Contractor:

- Drilling rig.
- Monitoring well casing.
- Monitoring well screen.
- Bottom caps, plugs or points.
- Centering guides (if they are to be used).
- Filter pack sand.
- Bentonite.



- Cement-bentonite grout.
- Mud-scale to measure densities.
- Protective casing or road box.
- Steam-cleaning apparatus and supplies.
- Suitable containers (e.g., Department of Transportation (DOT)-approved 55-gallon drums with liners) for soil cuttings, well development water, and water generated from steam cleaning.
- Metal stamps for permanently marking wells.
- All necessary permits and licenses.
- If the Geoprobe® is used for well installation, Geoprobe®-specific equipment for well installation.

3.2. Equipment Supplied by Loureiro Engineering Associates, Inc. (LEA)

- Field forms.
- Indelible markers.
- Lock(s) and keys.
- Well development equipment (pumps, surge block, bailers, etc.).
- Analytical instrumentation (Analytical instrumentation includes, but is not necessarily limited to turbidity meters, pH meters, specific conductivity meters, and thermometers.).
- Calibration supplies for all analytical instrumentation, as appropriate.
- Alconox®, or other non-phosphate laboratory grade detergent.
- 5-gallon buckets.
- Decontamination brushes.
- Distilled, de-ionized water.
- Decontamination fluids (<10% methanol in water, 100% n-hexane, and 10% nitric acid).

3.3. Equipment Selection and Specifications

The following specifications will be followed:

Cement-Bentonite Grout: If cement-bentonite is utilized, the cement-bentonite grout will be a mixture of 95 pounds of Type II Portland cement, 4 to 6 pounds of powdered sodium bentonite, and 5 gallons of potable water. The bentonite must be thoroughly mixed with the water before the cement is added. The cement bentonite grout shall have a density of 14 pounds/gallon.

Filter Pack Sand: All filter pack sand will be clean, well-rounded silica sand, in factory-sealed bags. The sand will conform to the most



recent version of the American Water Works Association (AWWA) Standard AWWA/ANSI A100 for water wells. In brief, the standard states that filter pack sand will have an average specific gravity of 2.5 with not more than 1% of the material having a specific gravity less than 2.25. Thin, flat or elongated particles shall not exceed 2% of the material, no more than 5% of the material shall be soluble in hydrochloric acid, and the material shall be washed and free of shale, mica, clay, dirt, loam, and organic impurities.

Bentonite: All bentonite will be pure, additive-free bentonite whether it is pellets, chips, or powder.

3.4. Equipment Decontamination

3.4.1. Equipment Decontamination for Monitoring Well Installation

All well materials and drilling equipment which are used to construct a monitoring well or piezometer must be clean and free of any potential contaminants. All well construction materials not certified by LEA personnel as decontaminated when delivered will be decontaminated by steam cleaning before being installed. Drilling equipment must also be decontaminated, prior to beginning work, by steam cleaning. Geoprobe® equipment shall be cleaned using a detergent such as Liquinox®.

All decontamination activities shall be completed at a specially constructed decontamination pad (or a portable decontamination unit). The decontamination pad shall be constructed before any drilling activity begins. The pad shall be constructed of high-density polyethylene (HDPE) liner material, of sufficient size and strength to allow the drill rig access to the pad, and bermed to contain the generated wastewaters.

3.4.2. Equipment Decontamination for Sampling Equipment and Well Development.

All materials and equipment used to sample soil or which enter a well must be clean and free of any potential contaminants. In general, the choice of decontamination procedures shall be based upon the site-specific contaminants and outlined in the site-specific work plan.



For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below shall be followed.

- 3.4.2.1. Prior to commencing any field activities, the following solutions (as appropriate for the anticipated contaminants) shall be prepared and placed into 500-ml laboratory squirt bottles: <10% methanol in water; 10% nitric acid in water; 100% n-hexane; distilled, de-ionized water. Other chemicals may be used for decontamination of site-specific contaminants if needed for decontamination of those contaminants.
- 3.4.2.2. In the field, prepare approximately 2.5 gallons of a solution of Alconox[®] (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.
- 3.4.2.3. Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting shall be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic shall be bermed to contain spills. The decontamination for Geoprobe[®] equipment shall be performed in buckets or in tubs.
- 3.4.2.4. The order for decontaminating equipment is as follows:
 - 1) Detergent scrub.
 - 2) De-ionized (DI) water rinse.
 - 3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
 - 4) DI water rinse.
 - 5) 10% nitric acid rinse (to be used only when metals are suspected as potential contaminants).
 - 6) DI water rinse.
 - 7) Methanol rinse (<10% solution).
 - 8) Air dry.

The order of decontamination may change if different chemicals are used.

- 3.4.2.5. Disposable materials such as cord shall not be decontaminated and shall be disposed of after use.



- 3.4.3. At the end of the project day, all spent decontamination fluids and materials, such as the polyethylene sheeting and personal protective equipment, shall be managed and/or disposed of in accordance with all applicable municipal, state, and federal regulations.

4. Procedures

4.1. Utilities

- 4.1.1. Notify the appropriate "one call" utility notification service (e.g. Call Before You Dig at 1-800-922-4455, Contractor ID: 10502) at least three working days prior to commencing operations on a site. The locations of all proposed borings must be clearly marked in the field prior to notification. The Project Engineer/Manager **must** call and confirm that each utility has been to the site and has marked their respective lines.
- 4.1.2. On private sites, consult with the Owner or other person knowledgeable about the site as to the locations of potential private or abandoned utilities and locate these prior to beginning work. Upon the discretion of the Project Engineer/Manager, a pipe locator can also be used to assist in locating utilities.
- 4.1.3. Note that OSHA may have additional requirements for location of utilities.
- 4.1.4. All efforts to locate underground utilities (including names of owner or designee and time) should be properly documented in the field logbook prior to onset of the work scheduled.

4.2. OSHA

- 4.2.1. The Senior LEA representative shall be the Competent Person required by OSHA for all work. However, this does not relieve other LEA representatives from bringing to his or her attention conditions, which may be unsafe or present a hazard to the drilling crew, the general public, or other workers on the site.

4.3. Monitoring Well and Piezometer Installation

The specific monitoring well installation methodologies are dependent upon the specific drilling method used. In general, monitoring wells will be constructed through the inside of the drill stem, once the borehole has been advanced to the desired depth. For



Geoprobe® monitoring wells, the wells will be constructed through the inside of stainless steel casing.

4.3.1. Borehole Advancement

If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole must be backfilled with bentonite pellets, bentonite chips, or a bentonite-cement slurry to a depth of approximately one foot below the intended well depth. Approximately one foot of clean sand must be placed on top of the backfill to return the borehole to the proper depth for the well installation.

For bedrock monitoring wells, the borehole shall be advanced to approximately one foot into competent bedrock and the isolation casing grouted into place. The grout is to be allowed to cure for at least 24 hours before drilling continues. After the grout has cured, the borehole is to be advanced using the appropriate technique (e.g., coring, air rotary, mud rotary) to the desired depth. If the borehole is advanced to a depth greater than that at which the well is to be set, the borehole shall be backfilled as described above.

For Geoprobe® installed wells and piezometers, the steel casing will be drilled to the specified depth of the bottom of the well using the Geoprobe® and in certain cases manually.

4.3.2. Installation of Well Screen and Casing

The appropriate lengths of well screen (with bottom cap, or plug, or well point) and casing must be joined watertight and carefully lowered inside the drill stem to the bottom of the borehole. If centering guides are used, they must be placed at intervals around the well casing, beginning no lower than 5 feet above the top of the screen.

4.3.3. Design and Installation of the Filter Pack

After the well screen and casing are installed in the borehole, the filter pack shall be installed. For monitoring wells in unconsolidated materials, the selection of the appropriate filter pack material shall be based upon a grain-size analysis of a sample collected from the intended screen interval. The selection of the appropriate filter pack material shall be based upon the methodologies presented in the *"Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells"* (EPA, 1989), the *"RCRA Ground Water Monitoring Technical Enforcement Guidance Document"* (EPA, 1986), or any state or local guidance, or regulatory documents which are available. In the



absence of grain size analyses, the filter pack material shall be selected based upon an experienced geologist's best judgment as to the appropriate material.

For bedrock monitoring wells, the well screen and filter pack are emplaced primarily to stabilize the borehole and are therefore not sized in the same manner as for a monitoring well in unconsolidated sediments. For typical bedrock monitoring wells, 10-slot well screen is appropriate. The selection of the appropriate filter pack material shall be based upon the slot size selected for the well screen.

A filter pack of clean silica sand will be placed around the well screen. Place the filter pack into the borehole at a uniform rate in a manner that will allow even placement of the sand. The drill stem shall be raised slowly while the sand is being placed to avoid caving of the borehole walls; the drill stem shall never be raised above the top of the filter pack during installation. Using a stainless steel weight on the end of a fiberglass tape, continuously sound the top of the filter pack as it is being installed. The filter pack shall extend from a depth of approximately one foot below the screened interval to a minimum height of one to two feet above the top of the well screen. However, this length may be adjusted if it would create the potential for cross-contamination or in the case of shallow water tables.

A finer-grained sand cap shall be installed for a minimum of one foot above the filter pack. This height may also be adjusted in the case of shallow water tables.

4.3.4. Installation of Impermeable Seal

An impermeable seal at least two feet thick must be placed on top of the fine sand cap. The seal may be composed of either bentonite pellets or a bentonite slurry. The pellets must be placed into the borehole in a slow and continuous manner that prevents bridging. This is especially important in deeper monitoring wells where the pellets may have to be emplaced through a considerable depth of standing water in the borehole.

The bentonite slurry shall be prepared by mixing approximately 15 pounds of bentonite powder with 7 gallons of water for each one cubic foot of slurry needed. The slurry shall be emplaced in the borehole via a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one foot of pipe. This will allow the slurry to be emplaced into the borehole without disturbing the fine sand cap. This procedure is especially important for the relatively deeper wells.



Verify the position of the top of the bentonite seal using a weighted tape measure. If all or a portion of the bentonite seal must be emplaced above the water table, hydrate the bentonite with clean water. Allow 30 minutes after adding the water for the bentonite to hydrate.

The thickness of the bentonite seal may be adjusted for wells completed in aquifers with shallow water tables.

4.3.5. Installation of Grout Backfill

Place an annular seal of cement-bentonite grout above the bentonite seal. Install the cement-bentonite grout continuously from the bottom of the annular space to the ground surface through a tremie pipe. The tremie pipe must be plugged on the bottom and have openings along the sides of the bottom one-foot length of pipe. This will allow the grout to be emplaced into the borehole without disturbing the bentonite seal. Alternatively, a bentonite slurry can be used.

4.3.6. Surface Completion

All monitoring wells will be finished at the surface with a concrete pad. The concrete pad shall typically be two-feet square and at least four inches thick. The concrete shall fill the borehole to a depth below the frost line. The pad shall be constructed in one continuous pour of concrete. Note that some of the cement-bentonite grout used for the annular seal may have to be removed to install the concrete pad. A survey pin may be installed in the concrete pad before it dries, if necessary.

For monitoring wells that will be completed above-grade, a locking steel protective casing shall be installed in the concrete. The protective casing shall extend at least three feet into the ground and two feet above ground. For monitoring wells that will be completed flush, a steel roadbox, suitable for traffic loads, with a gasketed cover and drain shall be installed.

Each well will be properly labeled on the exterior of the locking cap or protective steel casing with a metal stamp indicating the permanent well identifier.

4.3.7. Well Protection Bollards

Guard posts may be installed in high-traffic areas for additional protection. One to four guard posts would be installed around the protective casing, within the edges of the concrete pad. If used, guard posts will consist of concrete-filled steel tubes, at least 3 inches in diameter, painted with multiple coats of epoxy-based paint to prevent rust. The guard posts would extend at least two feet below ground and approximately three feet above ground.



5. Well Development

Monitoring well development may be accomplished by surging and bailing (or pumping), or over pumping. Other methods, such as air jetting, backwashing, or air-lift pumping, shall be avoided because these methods introduce fluids into the formation and may have unexpected influences on groundwater quality, if only for a short period of time.

Immediately upon opening the well, the air in the wellhead will be sampled for VOCs using a portable VOC analyzer, such as a Photovac MicroTIP®. The well cap shall be opened slightly and the sampling port of the VOC analyzer shall be inserted into the well. The maximum reading shall be recorded on the appropriate field paperwork. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.

Measures shall be taken during well sampling to prevent surface soils from coming in contact with the purging equipment and lines. Typically, a polyethylene sheet is placed on the ground providing adequate coverage for the equipment being used.

In addition, the procedures described in LEA SOP ID 10004 in the sections for Field Analysis, Well Evacuation, and Sample Withdrawal shall be followed.

5.1. Surging and Bailing

In surging and bailing, a well is developed by alternately surging a short section of the screen with a tight-fitting surge block. Begin by lowering the surge block to the top of the screened interval and swab the well with a pumping action with a typical stroke of 2 to 3 feet. (Begin surging at the top of the well intake to avoid having loosened material from "sand-locking" the surge block.) Do not surge the well too violently to avoid damaging the well screen or the filter pack. Remove the surge block at regular intervals and bail (or pump) the fine material from the well. Proceed with surging throughout the length of the well screen, being careful to avoid hitting the bottom of the well. Check the quality of the bailed water at regular intervals, as described in Section 5.3.

In cases where a considerable volume of sediment may initially be drawn into the well, begin surging the well gently in the casing above the well screen. Proceed with surging and bailing to the bottom of the screened interval.

5.2. Overpumping

In overpumping, a well is developed by operating a pump in the well at a capacity which greatly exceeds the formation's ability to supply water. The flow velocity into the well during overpumping usually greatly exceeds the flow velocity



induced during normal sampling. This increased velocity causes movement of particles from the formation into the well.

Begin developing the well by installing a suitable pump at the bottom of the well. Alternatively, a surface-mounted pump with a suction hose may be used if the drawdown inside the well will not exceed the pump's available lift. The discharge from the pump shall be directed to approved containers. The pump (or intake hose) must be equipped with a backflow-prevention valve to prevent introducing aerated water into the aquifer.

Start the pump and discharge water at the highest practical rate. If the well runs dry, stop the pump and allow the well to recharge. Check the quality of the discharged water at regular intervals as described in Section 4.3.

5.3. Completing Well Development

During bailing or pumping, measure and record water quality parameters to gauge the degree and effectiveness of development. Typically, pH, temperature, specific conductivity, and turbidity shall be checked at periodic intervals (but at least every three well-volumes) until the purge water begins to appear clear. Then measurements shall be made after each well volume until the parameters stabilize. The water quality parameters may be considered stable when:

- pH, temperature, and specific conductivity of consecutive measurements have relative percent differences (RPD), as defined below, of less than 10%; and,
- The turbidity is 5 NTU or less (applicable only in aquifers with low percentages of fines. This may not be achievable in all situations, but the turbidity shall be less than 50 NTU and shall stabilize with an RPD of less than 10%).

However, in no case shall the development stop before the above criteria are met, and:

- At least 3 well volumes have been removed; or,
- The well has been surged and pumped for at least 30 minutes.

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:



$$RPD = \frac{|M1 - M2|}{(M1 + M2)/2} \times 100\%$$

All well development equipment and supplies shall be thoroughly decontaminated prior to and between each monitoring well. Place all development water into properly labeled, suitable containers; leave all filled containers in an appropriate location.

6. Documentation

6.1. Well Development

Well development activities will be documented on the appropriate field forms, and specifically on the "Field Data Record Groundwater" and "Well Development Report" forms. Information provided on those forms includes: purge method, amount of water per well volume, instrument readings after purging of each well volume.

6.2. Monitoring Well Completion Log Forms

During the installation of a monitoring well, complete records must be kept of quantities and types of all well construction materials used.

A complete geologic log shall be kept during advancement of the borehole for the well. The procedures for completing geologic logs are presented in *Standard Operating Procedure for Geologic Logging of Unconsolidated Sedimentary Materials* (SOP ID 10015). However, the additional information pertinent to monitoring well installations shall be recorded on a separate form. A monitoring well completion form is provided in Attachment 1. In addition typical wellhead details – one for flush-mount well completions and one for above-grade completions - are provided as Figure 1. Whenever a monitoring well is installed, record all appropriate information concerning the quantity of materials used, the type and manufacturer of the materials, the mixtures of grouts or slurries, and any pertinent notes regarding the installation of each well.

After the project is completed, submit a copy of the attached Geologic Soil Boring/Well Completion Log Request Form along with copies of all Monitoring Well Completion forms for final typing and entry into the LEA database. The request form provides information on the types of final logs to be produced, the scale at which to plot the final forms, and notes common to all reports.



7. Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) procedures will be followed in compliance with the site-specific work plan.

8. References

- 8.1. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER 9950.1, September 1986.
- 8.2. EPA, *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA/600/4-89/034, 1989.

END OF DOCUMENT



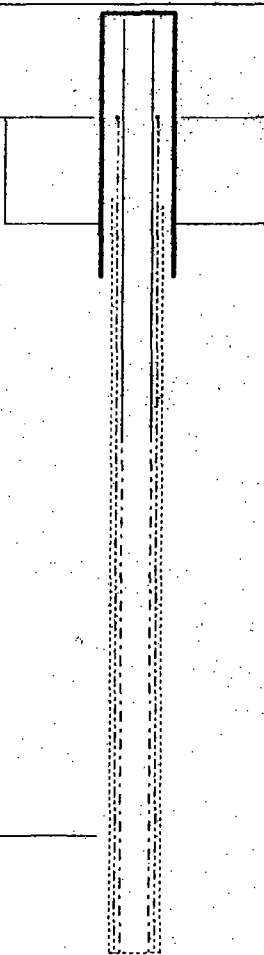
ATTACHMENT 1

**Monitoring Well Completion Report
and Well Development Forms**



WELL COMPLETION REPORT

Project: Emhart Des of Res Sy LEA Comm. No. 3481400. Client Emhart Industries, Inc. Location Emhart Industries former Headquarters		Start Date _____ End Date _____	Well ID _____
Drilling Contractor _____ Drilling Method _____ Sampling Method _____ Groundwater Observation _____ Depth _____ at _____ Hours _____		Logged by _____ Drilling Foreman _____ Drill Rig _____ GPS Latitude _____ GPS Longitude _____	

Protector Material _____ Diameter _____ Length _____ Ground _____ Stickup _____ Key # _____ Cover Type _____		Concrete Diameter _____ Concrete Thickness _____ Reference Stickup _____ Description _____ Casing Diameter _____ Material _____ Length _____ Stickup _____ Seal Top _____ Bottom _____ Material _____ Screen Top _____ Bottom _____ Material _____ Diameter _____ Length _____ Slot Size _____
Top Seal Top _____ Bottom _____ Material _____ Backfill Top _____ Bottom _____ Material _____ Secondary Sand Top _____ Bottom _____ Size _____ Filter Pack Top _____ Bottom _____ Material _____	Miscellaneous Materials (Quantity Used/Item) Cement _____ Bentonite Chips _____ Bentonite Pellets _____ Bentonite Powder _____ Grout Weight _____ Filter Pack Sand _____ Capping Sand _____ Well Point _____ Well Plug _____	

Reported depth to bottom of boring _____

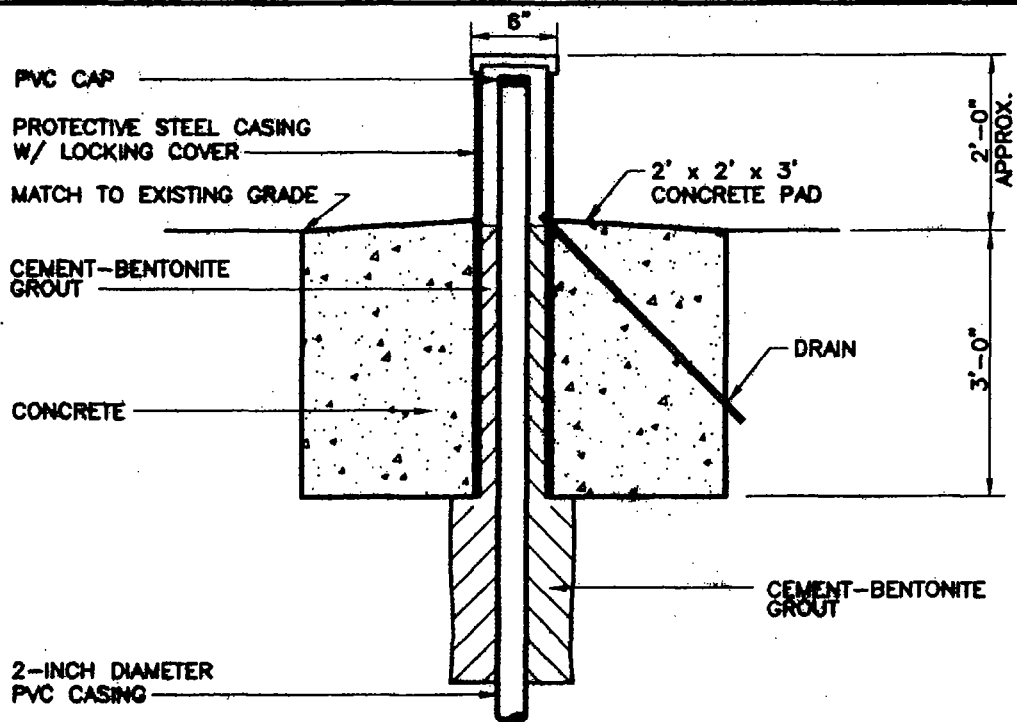
Comments _____

Signature _____

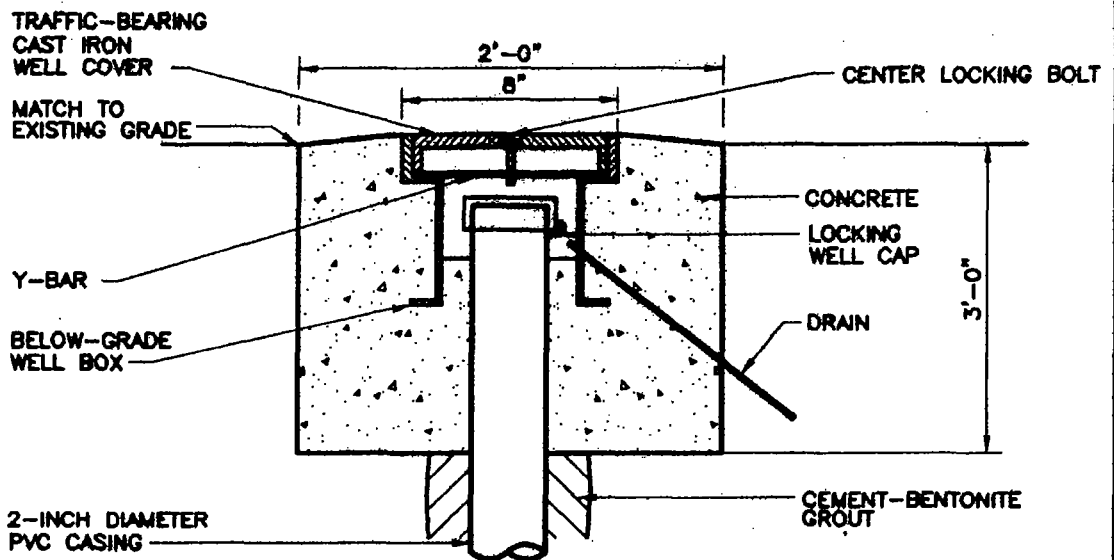


Loureiro Engineering Associates, Inc.

FIGURES



ABOVE GRADE WELLHEAD
CONSTRUCTION DETAIL - NOT TO SCALE



FLUSH TO GRADE WELLHEAD
CONSTRUCTION DETAIL - NOT TO SCALE

TYPICAL
WELLHEAD DETAILS

Comm.No.

FIG. 1

LEA

Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geologic Logging of Unconsolidated Sedimentary Materials

SOP ID: 10015
Date Initiated: 12/27/94
Revision No. 002: 01/15/02

Approved By: <u>/s/ Kimberly C. Clarke</u>	<u>01/15/02</u>
Kimberly C. Clarke	Date
Senior Project Scientist	
 <u>/s/ Nick D. Skoularikis</u>	 <u>01/15/02</u>
Nick D. Skoularikis	Date
Director Of Quality	

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	12/27/94	
001	11/20/96	No record
002	01/15/02	Formatting and minor revisions throughout



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geologic Logging of Unconsolidated Sedimentary Materials

1. Purpose and Scope

This document presents the methods and procedures used to describe unconsolidated sedimentary materials for geological purposes in a uniform and consistent manner. It includes procedures for properly recording the observations by providing guidelines for completing boring logs and submitting those logs for computer entry. This Standard Operating Procedure (SOP) refers only to geologic logging of soils and sediments (including artificial fill and other man-made deposits) and specifically is not intended to describe logging of soils or sediments for geotechnical or other engineering purposes. Although the SOP presents a system for describing sediments, it is not intended to be a definitive reference for classifying sedimentary materials, nor is it intended to replace experience or training. Individuals using this SOP should be trained and competent in field methodologies and geologic logging prior to commencing field activities.

2. Definitions

2.1. None

3. Equipment

3.1. Equipment required for the geologic logging of soil/sediment samples shall include the following items:

- Tape measure or scale.
- Hand lens.
- Color chart.
- Grain-size comparator.
- Field forms.
- Indelible marker(s).
- Small table.
- Field Paperwork.
- Clipboard.

4. Procedures

4.1. Sample Collection



Samples of soil and unconsolidated sedimentary materials will be collected in general accordance with the SOPs for Soil Sampling (SOP ID 10006), Hand Auger Borings (SOP ID 10003), Hollow Stem Auger Soil Borings (SOP ID 10008), and Geoprobe® Probing and Sampling (SOP ID 10011). Those SOPs include procedures for decontamination of equipment required for sample collection, as well as providing the methodologies for sample collection and documentation.

4.2. Descriptions of Unconsolidated Sedimentary Materials

4.2.1. General Sediment Description Guidelines

For the purposes of geologically logging unconsolidated soils and sedimentary materials, a Modified Burmister method of description and classification should be used. The Modified Burmister Sediment Classification System (or simply, Burmister System) is intended as a rapid field method for identifying and classifying sediments. The system is based upon visual identification of the generalized grain-size distribution and description of the physical characteristics of the sample.

A Burmister System description is comprised of three parts: a color descriptor; a grain-size descriptor; and modifier(s). The color descriptor indicates the overall color or colors of the wet sample. The descriptor consists of a color name or names and (if possible) the color code from a standard color reference (for example, a Munsell⁷ Color Chart). The grain-size description indicates the predominant grain size in the sample, as well as the relative percentages of other grain sizes present.

Modifiers are used to further describe the geologic character of the sample. Modifiers may include descriptions of moisture content, sorting, sphericity, angularity, sedimentary structures or other pertinent information.

4.2.2. Color Description

The color of the wet sediment should be determined with reference to a standard color comparator (for example, a Munsell⁷ Color Chart) for rocks or sediment. The included color descriptor should contain both the color name and, when a color comparator is used, the appropriate hue-chroma value code, for example "Reddish brown (5YR 4/4)". The color of a sample should always be gauged when the sample is wet, or it should be noted otherwise.

4.2.3. Predominant Grain-Size Description



The first step in describing a sediment sample is visually estimating the size range and percentage of the various grain sizes in the sample. Reference should be made to standard geologic comparators for assessment of the grain size(s).

The primary grain-size descriptor indicates the predominant grain size, as judged visually, of the sample. The descriptor is always capitalized and underlined. Possible descriptors include: CLAY, SILT, SAND, and GRAVEL (GRANULES, PEBBLES, COBBLES, and BOULDERS). These correspond to the standard Wentworth size-classification scheme used for describing sediments for geologic purposes. Size classifications for CLAY through GRAVEL are presented in Table 1. The descriptor should also include an indication of the relative size range of the sample within the predominant grain size (for example, "fine-to-medium sand", "coarse sand", etc.). Although Table 1 includes divisions of the silt category, this is applicable only to sediment samples analyzed by pipette or hydrometer and cannot be distinguished in the field.

The presence of other grain sizes, in addition to the predominant material is also included in the grain-size descriptor. Appropriate grain sizes are the same as for the predominant grain size of the material (clay, silt, etc.), however only the initial letter of the word is capitalized. The description should also include an indication of the relative amount of the minor components. Appropriate indicators for the relative percentages present are provided in Table 2.

It is generally not considered possible to visually distinguish between clay and silt. Estimation of the silt/clay content of a sample should be based upon the plastic properties of the sample. The plastic properties of the sample may be estimated by taking an approximately 1 cubic centimeter ball of the sediment and attempting to roll a thread of the material between the palms of the hand. The minimum size of the thread which may be rolled may be compared to the values presented in Table 3 and the plasticity estimated. A comparison of the minimum thread diameter which may be formed with the information presented in Table 3 provides an approximate silt/clay content estimate for sand-silt-clay sediments and composite clay sediments.

4.2.4. Modifiers

Various modifiers may be added to the basic sediment description to further describe the geologic character of the sample.



For sand or coarser-sized material, the relative degree of sorting, the sphericity, and angularity should also be recorded. Sorting may be visually estimated. Sphericity and angularity, however, should be made with reference to an accepted comparator. A chart illustrating various degrees of sphericity and angularity is attached as Figure 1.

The mineralogy of the sample should also be recorded. Reference should be made to the relative percentages, grain size(s), and sphericity of the mineral particles (especially where it differs significantly from that of the predominant grain-size material).

Other information which should be recorded for each sample includes an estimate of the density and cohesiveness of the sample (made from blow counts where applicable, or other specific instrumentation where appropriate), the relative moisture content of the sample, visible sedimentary structures, and any odors or staining noticeable during logging. Tables 3 and 4 present appropriate terms for describing the plasticity, density, and cohesiveness of sediment samples.

Especially important is an indication that a specific portion of the material may represent "sluff" or material collapsed from the borehole walls.

4.3. Written Sediment Descriptions

The written sediment description may be made as either an unabbreviated or an abbreviated description. Both methods should relate the same information, however the abbreviated description is better suited for field use.

In an unabbreviated description, all of the words of the description should be written out in their entirety. The descriptor should include pertinent information regarding the sample's size gradation, consistency, color, and relative grain size, as described previously. The color descriptor should precede the primary sediment component name, while additional details such as the plasticity, mineralogy, visible sedimentary structures, etc., should follow the sediment component name.

An example of an unabbreviated description is:

Red-brown (5YR 4/4), fine to coarse SAND, little fine Gravel, little Silt, moist, moderately well sorted, low sphericity, Gravel waterworn, Sand subangular, micaceous.



Since the Burmister system is intended to provide a means for describing uniform sediments, three "special" cases should be addressed.

First, the Burmister system is intended only to describe the sediment. Where a genetic classification of the material is significant, it should be added as a separate statement at the end of the description. For example:

Olive gray (5Y 4/2), coarse to fine SAND, some fine Gravel, little Silt, moist, poorly sorted, sub-rounded to angular, dense. TILL.

A genetic classification should only be used when the origin of the material is very clear and not simply a field interpretation of possible depositional environment.

Second, in the case where the sediment sample is heterogeneous (for example, a varved silt and clay), each component should be described individually, and reference should be made to the relative percentages of each component and to the interlayering. For example:

Soft, reddish-brown (5YR 3/4), CLAY and SILT, alternately layered, medium to high overall plasticity. Layers: CLAY layers, 3/8" to 5/8" thick, comprise 60%" of sample. SILT layers, 1/8" to 3/8" thick, comprise 40%" of sample. VARVED CLAY and SILT.

Third, when one material grades uniformly into a distinct sediment type, the individual components should be described separately and the gradation noted. For example:

Soft, reddish-brown (5YR 3/4), CLAY, medium overall plasticity, grading into soft, reddish-brown (5YR 4/4), SILT, trace Clay, low overall plasticity.

In the abbreviated sediment descriptions, the sample information is presented in a manner analogous to that for the unabbreviated description substituting standard abbreviations for specific portions of the text. Abbreviations for the identifying terms in the Burmister system are presented in Tables 2, 3, and 4. Mineralogic and geologic abbreviations may be found in standard geologic and mineralogic texts and field manuals. Except for the use of abbreviations, the abbreviated description is completely analogous to the unabbreviated description.



For the sake of consistency in describing unconsolidated sedimentary materials, the description should follow the order and general definitions presented in Table 5.

4.4. Recording Descriptions

4.4.1. Geologic Boring Logs

Attached to this SOP is a copy of LEA's standard geologic boring log form. This log should be completed for each boring that is completed. The heading information is self-explanatory. The body of the log contains space for information for each sampled interval in the boring. The following information should be recorded:

Depth Interval	The upper and lower depths from which the sample was collected.
Sample No.	The sample number, as obtained from LEA Data Management, assigned to this sample.
Recovery	The length of the recovered sample and the length of the sampler (in consistent units). The percent recovery will be calculated by the LEA Data Management program.
Blows/6"	The number of blow counts per 6" interval for the sample. Alternately, the downhole pressure or other pertinent information regarding the required drilling or sampling force.
Sample Description	The sample description using the guidelines and order presented in Section 3.0 and Table 5.
PID/FID	The headspace reading from a PID or FID in ppm.

The comments section of the form should be used to record general observations regarding drilling conditions, backfilling of the borehole, or other pertinent information regarding drilling the borehole.

4.5. Computer Data Entry

After a project is completed, copies of the Geologic Boring Log forms should be submitted for computer data entry. A completed copy of the Geologic Soil Boring/well Completion Log Request Form should be attached to the log forms.



5. Quality Assurance/Quality Control

- 5.1. Soil and sediment logging will be conducted in accordance with this SOP to ensure quality and consistency in field activities.
- 5.2. Field paperwork will be reviewed by office staff personnel and/or project manager to ensure completeness and accuracy in logging records.

6. References

- 6.1. None

END OF DOCUMENT



TABLE 1
Wentworth Size Classification System

US Standard Sieve Sizes	Millimeters	Microns	Phi (N)	Wentworth Size Classification	
Use Wire Squares	4096	4,096,000	-20	Boulder	GRAVEL
	1024	1,024,000	-10		
	256	256,000	-8		
				Cobble	
	64	64,000	-6		
				Pebble	
	16	16,000	-4		
5	4	4,000	-2		
				Granule	
6	3.36	3,360	-1.75		
7	2.83	2,830	-1.50		
8	2.38	2,380	-1.25		
10	2.0	2,000	-1.00		
				Very Coarse Sand	SAND
12	1.68	1,680	-0.75		
14	1.41	1,410	-0.50		
16	1.19	1,190	-0.25		
18	1.00	1,000	0.00		
				Coarse Sand	
20	0.84	840	0.25		



TABLE 1
Wentworth Size Classification System

US Standard Sieve Sizes	Millimeters	Microns	Phi (N)	Wentworth Size Classification
25	0.71	710	0.50	
30	0.59	590	0.75	
35	0.50	500	1.00	
40	0.42	420	1.25	Medium Sand
45	0.35	350	1.50	
50	0.30	300	1.75	
60	0.25	250	2.00	
70	0.210	210	2.25	Fine Sand
80	0.177	177	2.50	
100	0.149	149	2.75	
120	0.125	125	3.00	
140	0.105	105	3.25	Very Fine Sand
170	0.088	88	3.50	
200	0.074	74	3.75	



TABLE 1
Wentworth Size Classification System

US Standard Sieve Sizes	Millimeters	Microns	Phi (N)	Wentworth Size Classification	
230	0.0625	62.5	4.00	Coarse Silt	MUD
270	0.053	53	4.25		
325	0.044	44	4.50		
Analyzed by Pipette or Hydrometer	0.037	37	4.75	Medium Silt	
	0.031	31	5.0		
	0.0156	15.6	6.0		
	0.0078	7.8	7.0	Fine Silt	
	0.0039	3.9	8.0		
				Very Fine Silt	
				Clay (Note: Some use 2: (or 9N) as the clay boundary.)	
	0.0020	2.0	9.0		
	0.00098	0.98	10.0		
	0.00049	0.49	11.0		
	0.00024	0.24	12.0		
	0.00012	0.12	13.0		



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TABLE 1
Wentworth Size Classification System

US Standard Sieve Sizes	Millimeters	Microns	Phi (N)	Wentworth Size Classification
	0.00006	0.06	14.0	



Table 2 Modified Burmister System Descriptors				
Fractions		Proportion Descriptors		
(+)	Major Fraction	Quantity	Descriptor	Abbreviation
(-)	Minor Fraction	35% - 50%	and	a
e.g., a medium to coarse SAND which is predominantly medium grained would be written as: m(+) - c SAND		20% - 35%	some	s
		10% - 20%	little	l
		1% - 10%	trace	t
Modifiers: (+) Upper a of the range (-) Lower a of the range				

Table 3 Plasticity of Sediment Samples						
Material	Symbol	Feel	Ease of Rolling Thread	Minimum Thread Diameter	Plasticity Index	Plasticity
Clayey SILT	CyM	Rough	Difficult	1/4"	1 to 5	Slight (SI)
SILT & CLAY	M & C	Rough	Less Difficult	1/8"	5 to 10	Low (L)
CLAY & SILT	C & M	Smooth, dull	Readily	1/16"	10 to 20	Medium (M)
Silty CLAY	MyC	"Shiny"	Easy	1/32"	20 to 40	High (H)
CLAY	C	Waxy, very shiny	Easy	1/64"	40 +	Very High (VH)

Table 4 Density and Cohesiveness of Sediment Samples			
Density of Cohesionless Soils		Consistency of Cohesive Soils	
Blow Counts	Relative Density	Blow Counts	Consistency
0 to 4	Very Loose	0 to 2	Very Soft
5 to 9	Loose	2 to 4	Soft
10 to 29	Medium Dense	4 to 8	Medium
30 to 49	Dense	8 to 15	Stiff
50 to 79	Very Dense	15 to 30	Very Stiff
80 or more	Extremely Dense	30 or more	Hard



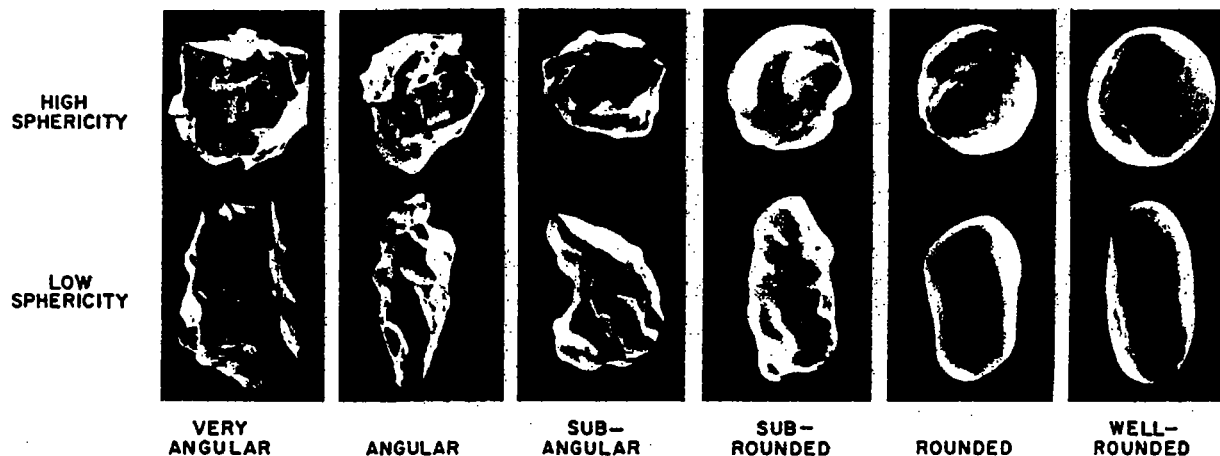
Table 5
Description of Sediment Properties

Sediment Parameter	Properties
Color	The color of the sample should be described for the wet sediments. If possible the color should be referenced to a standard color chart such as a Munsell7 Color Chart.
Primary Grain Size	Primary grain size refers to the size of the predominant sedimentary size class within the material (as judged visually). The grain size divisions should conform to the standard Wentworth Scale divisions, as shown in Table 1.
Secondary Grain Size(s)	Secondary grain size(s) refer to material which, as a grain-size group, comprises less than the majority of the sediment. Aside from stating the size classification, the relative percentage of the material must be stated. The grain size divisions should conform to the standard Wentworth Scale divisions as shown in Table 1. To describe the approximate percentage of the secondary grain size(s) present, qualifiers shown in Table 2 should be used.
Moisture Content	The moisture content of the sample should be described as dry, slightly moist, moist, or wet. Gradation from one state to another should be recorded as, for example, moist to wet, or moisty wet.
Sorting	The relative degree of sorting of the sediment should be indicated as poor, moderate, good, or very good. The degree of sorting is a function of the number of grain size classes present in the sample; the greater the number of classes present the poorer the sorting. In addition, for samples composed only of sand, the relative degree of sorting is a function of the number of sand-size subclasses present.
Sphericity	Sphericity is a measure of how well the individual grains, on average, approximate a sphere. The average sphericity of the sand and larger size fractions should be described as low, moderate or high. A chart illustrating various degrees of sphericity is presented in Figure 1.
Angularity	Angularity, or roundness, refers to the sharpness of the edges and corners of a grain (or the majority of the grains). Five degrees of angularity are shown in Figure 1: Angular (sharp edges and corners, little evidence of wear); Subangular (edges and corners rounded, faces untouched by wear); Subrounded (edges and corners rounded to smooth curves, original faces show some areas of wear); Rounded (edges and corners rounded to broad curves, original faces worn away); and, Well Rounded (no original edges, faces, or curves, no flat surfaces remain on grains).
Sedimentary Structures	Sedimentary structures are such things as varved layers, distinct bedding, or stratification.
Density -or- Cohesiveness	The density of cohesion of a sample (for the purposes of this application) refer to the sample's resistance to penetration by a sampling device. Density is used in reference to sediments primarily silt-size and coarser while cohesiveness is used in reference to primarily clay-sized sediments. Density or cohesiveness can be assessed from the number of blows from "standard" split-spoon sampling (i.e., 140# hammer, 30" fall, 2" X 2" (O.D., 1 3/8" I.D.)) split-spoon samplers according to the scale in Table 3.



FIGURE 1

DEGREES OF ROUNDNESS

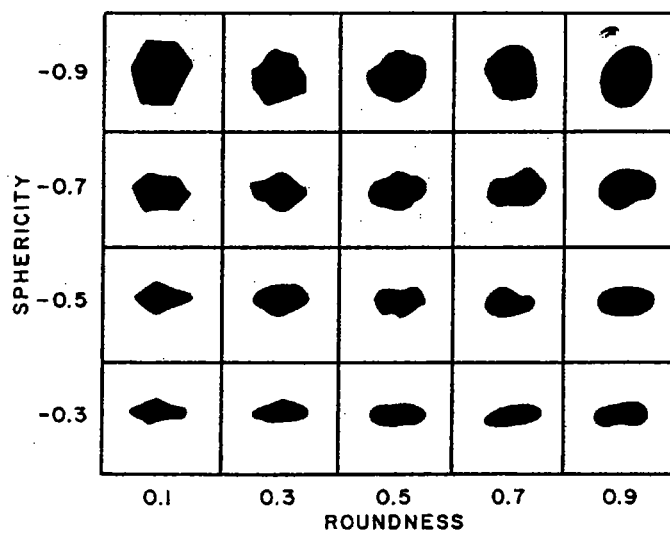


SPHERICITY

0.3 LOW
0.5 & 0.7 MODERATE
0.9 HIGH

ROUNDNESS

0.1 ANGULAR
0.3 SUBANGULAR
0.5 SUBROUNDED
0.7 ROUNDED
0.9 WELL ROUNDED



**Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geoprobe® Probing and Sampling**

**SOP ID: 10011
Date Initiated: 11/10/94
Revision No. 005: 12/31/01**

Approved By: <u>/s/ David C. Brisson</u>	<u>01/03/02</u>
David C. Brisson	Date
Project Geologist	
 <u>/s/ Nick D. Skoularikis</u>	 <u>01/03/02</u>
Nick D. Skoularikis	Date
Director of Quality	

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	11/10/94	
001-002	-	No record.
003	06/17/97	No record.
004	07/19/00	Revisions to template, including new logo. Revisions to Sections 3, 4, 5 and 6 in order to generalize sampling procedures and reference Geoprobe® Systems' catalog and specific soil sampling standard operating procedures.
005	12/31/01	Revisions made to reflect new SOP format. Addition of QA/QC section, minor changes throughout.



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Geoprobe® Probing and Sampling

1. Purpose and Scope

The objective of this standard operating procedure (SOP) is to collect discrete soil samples at depth using Geoprobe® probing and sampling methodologies and to recover the samples for visual inspection and/or analysis. Procedures for soil sampling for analysis are included in *Loureiro Engineering Associates (LEA) SOP for Soil Sampling*, SOP ID 10006.

2. Definitions

- 2.1. **Geoprobe®***: A vehicle-mounted, hydraulically-powered, soil probing machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

*Geoprobe is a registered trademark of Kejr Engineering, Inc., Salina, Kansas.

- 2.2. **Sampler**: A piston type soil sampler capable of recovering a discrete sample in the form of a core contained inside a removable liner.
- 2.3. **Liner**: A removable/replaceable, thin-walled tube inserted inside the sampler body for the purpose of containing and storing soil samples. Liner materials include brass, stainless steel, Teflon®, and clear plastic (either PETG or cellulose acetate butyrate).

3. Equipment

The equipment required to recover soil core samples using the Geoprobe® samplers and driving system can be found in the Geoprobe® Systems catalog for tools and equipment, as referenced in Section 6. Sample liners for the Geoprobe® samplers are available in four different materials. Liner materials should be selected based on sampling purpose, analytical parameters, and data quality objectives. A listing of the general parts and equipment from the Geoprobe® Systems catalog for tools and equipment is provided below:



<u>Geoprobe® Tools</u>	<u>Part Number</u>
Probe Rod (4 Foot)	AT104B
Probe Rod (3 Foot)	AT10B
Probe Rod (2 Foot)	AT105B
Probe Rod (1 Foot)	AT106B
Drive Cap	AT11B
Pull Cap	AT12B
Extension Rod	AT67
Extension Rod Coupler	AT68
Extension Rod Handle	AT69
MC Drive Head	AT8510
MC Cutting Shoes	AT8530,8535,8537
MC Piston Tip Assembly	AT8570
MC Spacer Ring or Core Catcher	AT8531K,8532K
MC Sample Tube	AT8522
MC PETG Liner	AT825K
MC Combination Wrench	AT8590
MC Release Rod	AT8580
MC Extension Rod	AT671
Extension Rod Coupler	AT68
Ext. Rod Quick Links	AT694K
Ext. Rod Handle	AT69
MC Vinyl End Caps	AT726K
Liner Cutter Kit	AT8000K
Nylon Brush for Macro Tubes	BU700

4. Procedure

4.1. Utilities Clearance

- 4.1.1. Notify the appropriate "one call" utility notification service (e.g., in Connecticut, Call Before You Dig at 1-800-922-4455) at least three working days prior to commencing operations on a site. The locations of all proposed borings must be clearly marked in the field prior to notification. The Project Engineer/Manager **must** call and confirm that each utility has been to the site and has marked their respective lines.
- 4.1.2. On private sites, consult with the owner or other person knowledgeable about the site as to the locations of potential private or abandoned utilities and locate these prior to beginning work. Upon the



discretion of the Project Engineer/Manager, a pipe locator can also be used to assist in locating utilities.

4.1.3. Note that the Occupational Safety and Health Administration (OSHA) may have additional requirements for location of utilities.

4.1.4. All efforts to locate underground utilities (including names of owner or designee and time) should be properly documented in the field logbook or field paperwork prior to onset of the work scheduled.

4.2. Health and Safety

The foreman or supervisor of the drilling crew shall be the competent person as required by OSHA for all of their work. However, this does not relieve any other LEA representative from bringing to his or her attention conditions which may be unsafe or present a hazard to the drilling crew, the general public, or other workers on the site. The LEA representative is responsible for ensuring that LEA activities are conducted in accordance with the site-specific Health and Safety Plan.

4.3. Site Preparation

4.3.1. A sufficient area shall be cordoned off to restrict access to the work area. This area shall be termed an "Exclusion Zone".

4.3.2. An equipment decontamination area shall be assembled as described in Section 4.14 within the exclusion zone.

4.3.3. All personal protective equipment as required in the site-specific health and safety plan shall be donned.

4.4. General Sampler Assembly

4.4.1. The sampler is connected to the leading end of a Geoprobe® probe rod and driven into the subsurface using a Geoprobe® drilling apparatus. Additional probe rods are connected in succession to advance the sampler to depth. The sampler remains sealed (closed) by a piston tip as it is being driven. The piston is held in place by a reverse threaded stop pin at the trailing end of the sampler. The first four-foot interval does not require the piston tip assembly. In addition, if the borehole remains open, the piston tip assembly may not be required for deeper intervals. If there is evidence that the borehole is collapsing, the piston tip will be utilized.



- 4.4.2. When the sampler tip has reached the top of the desired sampling interval, a series of extension rods, sufficient to reach depth, are coupled together and lowered down the inside diameter of the probe rods. The extension rods are then rotated clockwise (using a handle). The male threads on the leading end of the extension rods engage the female threads on the top end of the stop pin, and the pin is removed.
- 4.4.3. After the extension rods and stop pin have been removed, the tool string is advanced an additional 24 to 48 inches (depending on the soil sampling system in use). The piston is displaced inside the sampler body by the soil as the sample is cut. To recover the sample, the sampler is recovered from the hole and the liner containing the soil sample is removed.
- 4.4.4. Refer to the Geoprobe® System standard operating procedures for operation of various soil sampling systems (e.g., Macro Core Piston Rod Soil Sampling System, DT21 Dual Tube Soil Sampling System, Large Bore Soil Sampling System).

4.5. Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sand, or rubble. Preprobing can prevent unnecessary wear on the sampling tools. A specific Geoprobe® preprobe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval. Where surface pavements are present, a hole may be drilled with the Geoprobe® using a specific drill steel bit (AT-32, -33, -34, or -35, depending upon the thickness of the pavement), tipped with a 1.5 inch diameter carbide drill bit (AT-36) prior to probing. For pavements in excess of 6 inches, the use of compressed air to remove cuttings is recommended.

4.6. Concrete Coring

Should the borehole be located on concrete, the Geoprobe® can be used to core through the concrete to gain access to the underlying soil. A carbide-tipped drill bit (AT36-39) and Geoprobe® drill steel (AT3524, 3536, 3548) will be attached to the drill assembly and utilized to core the concrete. For concrete in excess of 16 inches, other methods (i.e., a core saw) should be utilized to penetrate the concrete.

4.7. Driving

- 4.7.1. Attach a probe rod to the assembled sampler and a drive cap to the probe rod. Position the assembly for driving into the subsurface.



Make sure the assembled sampler is relatively perpendicular to the ground surface. A level can be utilized if drilling on uneven ground.

- 4.7.2. Drive the assembly into the subsurface until the drive head of the sample tube is just above the ground surface.
- 4.7.3. Remove the drive cap and the probe rod. Secure the drive head with a 1-inch or adjustable wrench and retighten the stop pin with a 3/8-inch wrench.
- 4.7.4. Attach a 2-foot probe rod and a drive cap, and continue to drive the sampler into the ground. Attach 3-foot probe rods in succession until the leading end of the sampler reaches the top of the desired sampling interval.

4.8. Preparing to Sample

- 4.8.1. When the sampling depth has been reached, position the Geoprobe® machine away from the top of the probe rod to allow room to work.
- 4.8.2. Insert an extension rod down the inside diameter of the probe rods. Hold onto it and place an extension rod coupler on the top threads of the extension rod (the down hole end of the leading extension rod should remain uncovered). Attach another extension rod to the coupler and lower the jointed rods down-hole.
- 4.8.3. Couple additional extension rods together in the same fashion as in Step 2. Use the same number of extension rods as there are probe rods in the ground. The leading extension rod must reach the stop-pin at the top of the sampler assembly. When coupling extension rods together, you may opt to use the extension rod jig to hold the down-hole extension rods while adding additional rods.
- 4.8.4. When the leading extension rod has reached the stop pin down-hole, attach the extension rod handle to the top extension rod.
- 4.8.5. Turn the handle clockwise (right handed) until the stop pin detaches from the threads on the drive head. Pull up lightly on the extension rods during this procedure to check thread engagement.
- 4.8.6. Remove the extension rods and uncouple the sections as each joint is pulled from the hole. The extension rod jig may be used to hold the rod couplers in place as the top extension rods are removed.



- 4.8.7. The stop pin should be attached to the bottom of the last extension rod upon removal. Inspect it for damage. Once the stop pin has been removed, the sampler is ready to be redriven to collect a sample.

4.9. Sample Collection

- 4.9.1. Reposition the Geoprobe® machine over the probe rods, adding an additional probe rod to the tool string if necessary. Make a mark on the probe rod 24 inches above the ground surface (this is the distance the tool string will be advanced).
- 4.9.2. Attach a drive cap to the probe rod and drive the tool string and sampler another 24 inches. Use of the Geoprobe®'s hammer function during sample collection may increase the sample recovery in certain formations. Do not overdrive the sampler.

4.10. Retrieval

- 4.10.1. Remove the drive cap on the top probe rod and attach a pull cap. Lower the probe shell and close the hammer latch over the pull cap.
- 4.10.2. With the Geoprobe® foot firmly on the ground, pull the tool string out of the hole. Stop when the top (drive head) of the sampler is about 12 inches above the ground surface.
- 4.10.3. Because the piston tip and rod have been displaced inside the sample tube, the piston rod now extends into the 2-foot probe rod section. In loose soils, the 2-foot probe rod and sampler may be recovered as one piece by using the foot control to lift the sampler the remaining distance out of the hole.
- 4.10.4. If excessive resistance is encountered while attempting to lift the sampler and probe rod out of the hole using the foot control, unscrew the drive head from the sampler and remove it with the probe rod, the piston rod and the piston tip. Replace the drive head onto the sampler and attach a pull cap to it. Lower the probe shell and close the hammer latch over the pull cap and pull the sampler the remaining distance out of the hole with the probe machine foot firmly on the ground.

4.11. Sample Recovery

- 4.11.1. Detach the 2-foot probe rod if it has not been done previously.



- 4.11.2. Unscrew the cutting shoe using the cutting shoe wrench, if necessary. Pull the cutting shoe out with the liner attached. If the liner doesn't slide out readily with the cutting shoe, take off the drive head and push down on the sidewall of the liner. The liner and sample should slide out easily.

4.12. Core Liner Capping

- 4.12.1. The ends of the liners can be capped off using the vinyl end cap for further storage or transportation. A black end cap should be used at the bottom (down end) of the sample core and a red end cap at the top (up end) of the core.
- 4.12.2. On brass, stainless steel, and Teflon[®] liners, cover the end of the sample tube with Teflon[®] tape before placing the end caps on the liner. The tape should be smoothed out and pressed over the end of the soil core so as to minimize headspace. However, care should be taken not to stretch and, therefore, thin the Teflon[®] tape.
- 4.12.3. The soil boring identifier and depth of sample should be marked at the top of the core (on the red end cap).

4.13. Sample Removal

- 4.13.1. Clear plastic and Teflon[®] liners can be slit open easily with a utility knife for the samples to be analyzed or placed in appropriate containers.
- 4.13.2. Brass and stainless steel liners separate into four 6 inch sections. The manual extruder may be used to push the soil cores out of the liner sections for analysis or for transfer to other containers.
- 4.13.3. The procedures for collection of soil samples for chemical analysis are described in the *Standard Operating Procedure for Soil Sampling*.
- 4.13.4. Soil samples collected for archive purposes shall be placed into soil jars and labeled with sample numbers, date, time, and LEA commission number.

4.14. Equipment Decontamination and Cleaning

- 4.14.1. Prior to conducting a boring, the LEA representative will ensure that all necessary equipment is clean and decontaminated, including the rig, all augers and probing equipment, samplers, brushes, and any



other tools or equipment. Decontamination procedures may vary slightly from those presented below, dependent upon the particular types of contaminants encountered.

- 4.14.2. A section of 5 mil (minimum) plastic sheeting shall be cut of sufficient size to underlie the decontamination area to contain any discharge of decontamination solutions.
- 4.14.3. The following solutions (as appropriate for the anticipated contaminants) shall be prepared and placed in 500 ml laboratory squirt bottles:
- Methanol solution in water (less than 10 percent).
 - 10 percent nitric acid solution in water (less than 10 percent).
 - 100 percent hexane solution (to be used only if separate-phase petroleum product, other than gasoline, is present).
 - Distilled deionized (DI) water.
- 4.14.4. A fifth solution of phosphate-free detergent and tap water (approximately 2.5 gallons) shall be prepared in a five-gallon bucket. Only those solutions required for site-specific conditions will be used at a given site, as specified in the site-specific work plan.
- 4.14.5. All loose debris shall be removed from the augers and spatulas into an empty 5-gallon bucket or plastic sheeting using a stiff bristled brush.
- 4.14.6. The order of decontamination solutions is as follows:
- Detergent scrub.
 - Distilled water rinse.
 - Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
 - Distilled water rinse.
 - 10 percent nitric acid rinse (to be used only when metals are suspected as potential contaminants).
 - Distilled water rinse.
 - Methanol rinse (less than 10 percent solution).
 - Air dry.



- 4.14.7. All sampling equipment shall be decontaminated at the beginning of each project, in between sample collection, and at the completion of the project.
- 4.14.8. An alternative to the procedure described above requires that the larger equipment be cleaned using a high-pressure wash and steam cleaning in an area constructed to contain spent decontamination fluid and debris (plastic sheeting bermed with timber is usually sufficient). Alternative methods of cleaning may be more appropriate for an individual piece of equipment for site conditions based upon knowledge of site contaminants, and may be used at the discretion of the LEA representative. Section 4.19 provides additional information on management of potentially contaminated fluids and materials.
- 4.14.9. At the end of the project day, all used equipment shall be decontaminated. All spent decontamination solutions will be handled and disposed of in accordance with all applicable municipal, state and federal regulations.

4.15. VOC Monitoring

- 4.15.1. A portable volatile organic compound (VOC) analyzer equipped with a photoionization detector (PID) or flame ionization detector (FID) shall be available on site and shall be used to screen all cuttings and fluids (if any) removed from the hole.
- 4.15.2. Since, in general, it cannot be presumed that there is no contamination at a given site, all cuttings and/or fluids which show a reading on the VOC analyzer that is above background shall be containerized or drummed, as appropriate, on site. The soil cuttings should be containerized if the presence of other contaminants (such as metals, semivolatile organic compounds) is known or suspected. Additional information on management of potentially contaminated fluids and materials is presented in Section 4.19.

4.16. Sample Collection and Documentation

The following procedures will be followed for sample collection following removal from the borehole.

- 4.16.1. The sample tube shall be opened by the LEA representative and immediately scanned using the VOC analyzer using the approach described in Section 4.17.



- 4.16.2. The LEA representative will record on the boring log information described in Section 4.18.2.
- 4.16.3. Prior to reuse, the sampler shall be decontaminated using the procedures described in Section 4.14.
- 4.16.4. Soil samples collected for archival purposes shall be placed into soil jars and labeled with the sample number, date, time, and LEA commission number.
- 4.16.5. The procedures for collection of soil samples for chemical analysis are described in the *Standard Operating Procedure for Soil Sampling*.

4.17. Field Analysis

- 4.17.1. The following procedure shall be used to obtain readings with a portable VOC analyzer of the VOCs present in a soil sample:
 - Obtain an aliquot of soil (approximately 50 grams) from the split spoon and placed into a plastic bag or equivalent and sealed.
 - Agitate the sample, assuring that all soil aggregates are broken, for at least two minutes.
 - Carefully break the seal of the bag enough to insert the VOC probe.
 - Record the maximum reading obtained on the appropriate forms, as described in Section 4.18.

4.18. Field Documentation

- 4.18.1. The following general information shall be recorded in the field log book and /or appropriate field forms:
 - Project and site identification.
 - LEA commission number.
 - Field personnel.
 - Name of recorder.
 - Identification of borings.
 - Collection method.
 - Date and time of collection.
 - Types of sample containers used, sample identification numbers and QA/QC sample identification.
 - Field analysis method(s).
 - Field observations on sampling event.
 - Name of collector.



- Climatic conditions, including air temperature.
- Chronological events of the day.
- Status of total production.
- Record of non-productive time.
- QA/QC data.
- Name of drilling firm.
- Location of boring(s) on site in sufficient detail to relocate boring at a future time (include sketch).

4.18.2. The following information shall be recorded in the boring log:

- Project name, location, and LEA commission number.
- Borehole number, borehole diameter, boring location, drilling method, contractor, groundwater observations, logger's name and date.
- Depth below grade, sample number, duplicate numbers, VOC analyzer reading, rig behavior (i.e., drilling effort, etc.).
- A complete sample description following SOP ID 10015, *Geologic Logging of Unconsolidated Sedimentary Deposits*. This will include, as a minimum: depth, material size gradation using the Burmister system, color, moisture, and density. Should a well be constructed in a borehole, a complete well schematic shall be drawn and accurately labeled.
- Use of water, including source(s) and quantity.

4.18.3. The following information shall be recorded on the QA Checklist provided in the Daily Field Report:

- Review of all necessary site activities and field forms.
- Statement of corrective actions for deficiencies.

4.18.4. Any instrument calibration information shall be recorded in the "Instrument Calibration" section provided in the Daily Field Report, and shall include the following information:

- Instrument make, model, and type.
- Calibration readings.
- Standards and backgrounds used for calibration.



4.19. Disposal of Potentially Contaminated Materials

Potentially contaminated cuttings or fluids, as indicated by knowledge of the site, discoloration, VOC analyzer readings, or other evidence, shall be containerized on-site pending sampling and determination of hazardous waste status.

4.20. Refusal

Refusal is defined as failure to penetrate the subsurface materials to any greater depth using the maximum reasonable pressure limits of the Geoprobe[®] machine.

4.21. Bedrock

The term "bedrock" will not be used in a boring log or other description of subsurface materials that have been collected using the Geoprobe[®] machine, since a confirmatory core cannot be collected.

4.22. Boring Abandonment

4.22.1. If the boring is not to be used for other purposes (i.e., monitoring well, soil vapor probe, soil vapor extraction well, etc.) it shall be abandoned.

4.22.2. The boring shall be filled and sealed with neat cement grout or high-density bentonite clay grout as soon as the tools are withdrawn from the borehole.

4.22.3. Excess cuttings shall be containerized, labeled and the analytical data of the contents reviewed/profiled before disposal.

4.22.4. In paved areas, the upper three feet of the borehole shall be filled, up to two inches below the existing grade, to allow for repairing of the pavement.

4.22.5. Pavement shall be repaired using cold patch asphalt filler or concrete.

5. Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) procedures shall comply with the procedures described in LEA SOP ID 10004. QA/QC samples, if required, (including performance evaluation samples, equipment blank samples, trip blank samples, and field duplicate samples) shall be collected according to the site-specific work plan.



6. References

- 6.1. Geoprobe® Systems, 1997, *1998-1999 Tools and Equipment Catalog*.
- 6.2. Geoprobe® Systems, *Geoprobe® Macro-Core Soil Sampler Standard Operating Procedure*, Technical Bulletin No. 95-8500, prepared 11/95, revised 09/98
- 6.3. Geoprobe® Systems, *Geoprobe® DT21 Dual Tube Soil Sampling System, Continuous Core Soil Sampler Standard Operating Procedure*, Technical Bulletin No. 982100, 09/98
- 6.4. Geoprobe® Systems, *Geoprobe® Large Bore Soil Sampler, Discrete Interval Soil Sampler Standard Operating Procedure*, Technical Bulletin No. 93-660, prepared 09/96, revised 04/98.

END OF DOCUMENT



**Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Liquid Sample Collection and Field Analysis**

**SOP ID: 10004
Date Initiated: 02/20/90
Revision No. 006: 12/31/01**

Approved By: <u>/s/ Joseph T. Trzaski</u>	<u>12/31/01</u>
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Senior Scientist	
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Director of Quality	

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	2/20/90	
001-004	NR	No record.
005	01/15/99	No record.
006	12/31/01	Updated to conform to new SOP format. Minor revisions throughout.



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Liquid Sample Collection and Field Analysis

1. Purpose and Scope

This document describes procedures to be followed for measurement of static water level elevations, detection of immiscible layers, well evacuation, sample withdrawal, and field analyses.

2. Definitions

2.1. Immiscible layers: The term is used to denote free-phase liquids that may be present in the aquifer as a result of a release. These liquids may have a density lighter than water (light non-aqueous phase liquids (LNAPL) or floaters) or heavier than water (dense non-aqueous phase liquids (DNAPL) or sinkers).

3. Equipment

3.1. Equipment required for the collection and field analysis of liquid samples includes:

- Water-level indicator (accurate to 0.01 foot). The size of the instrument depends on the size of the wells being monitored.
- Distilled water.
- Hand towels.
- Portable volatile organic compound (VOC) analyzer (Photovac MicroTIP®, Foxboro OVA® or equivalent).
- Interface probe, clear polyvinyl chloride (PVC) or fluorocarbon resin bailer (if required).
- pH and temperature meter (capable of accuracy to 0.1 pH unit).
- Specific conductivity meter.
- Bailers (clean or disposable) with disposable nylon or polyethylene rope.



- Polyethylene plastic sheeting.
- Polyethylene tubing, and appropriate pumping apparatus such as centrifugal pump, Wattera® pump with fluorocarbon resin foot valve, peristaltic pump with appropriate tubing, submersible pump or other appropriate pumping apparatus.
- Clean disposable gloves.
- Field paperwork.
- Sample collection jars.
- Indelible marker.
- Cooler(s) with ice or ice packs.
- Site-specific Health and Safety Plan (as applicable).
- Site-specific work plan, work instructions, drawings (as applicable).
- Personal protective equipment (as may be required by Site Specific Health and Safety Plan).
- Aluminum foil (if field decontamination is expected).
- Appropriate containers for collection of purge water (bucket, carboy, 55-gallon drum etc.).

4. Procedures

Immediately upon opening the well, the air in the wellhead should be sampled for VOCs using a portable VOC analyzer, such as a Photovac MicroTIP®. The well cap shall be opened slightly and the sampling port of the VOC analyzer shall be inserted into the well. The maximum reading shall be recorded on the appropriate field paperwork. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.

Measures shall be taken during well sampling to prevent surface soils from coming in contact with the purging equipment and lines. Typically, a polyethylene sheet is placed on the ground providing adequate coverage for the equipment being used.

4.1. Detection of Immiscible Layers

- 4.1.1. If the presence of immiscible layers is suspected or unknown, the sampling event shall include provisions for detection of immiscible phases prior to well evacuation or sample collection. Lighter and/or



denser immiscible phases may be encountered in a groundwater monitoring well.

- 4.1.2. An interface probe will be used to determine the existence of any immiscible layers, light or dense. Alternatively, a clear fluorocarbon resin or PVC bailer may be used to determine the existence of the phases or oil sheen in the well when no accurate determination of the immiscible layer thickness is required. For Geoprobe® wells smaller than 1" in diameter, an interface probe cannot be introduced into the well. A small diameter disposable bailer can be used to determine the existence of any immiscible layers. Alternatively the initial water purged from a well will be collected and evaluated visually for the presence of immiscible layers.
- 4.1.3. If immiscible layers were encountered, the levels of the immiscible liquids shall be measured to an accuracy of 0.02 feet using an electronic interface probe capable of detecting the interfaces between air, product, and water. The interface levels shall be recorded in the field notebook. Adjustments of the observed head to the theoretical hydraulic head shall be calculated based on the density conversion factor associated with the particular non-aqueous phase liquid.
- 4.1.4. If required, the immiscible layers and groundwater shall then be purged into 55-gallon 17H DOT drum, which shall be labeled and characterized for disposal. The immiscible layer shall be collected prior to any purging activities.

4.2. Measurement of Static Water Level

- 4.2.1. The static water elevations in each well shall be measured prior to each sampling event. This is performed initially to characterize the site, and in subsequent sampling rounds to determine whether horizontal or vertical flow gradients have changed. A change in hydrologic conditions may necessitate modification of the groundwater monitoring program.
- 4.2.2. Remove the protective cover and locking cap.
- 4.2.3. Each well shall have a surveyed reference point located at the top of the well casing with the locking cap removed. The reference point shall be easily recognizable, since the personnel conducting the sampling may differ from one sampling event to the next. If no distinguishable reference point is present, the measurements shall be



taken from the highest point on the well casing. The absence of a reference point and subsequent reference point used for the measurements shall be recorded on the field paperwork.

4.2.4. The following parameters shall be measured with an accuracy of 0.01 ft:

- Depth to standing water.
- Depth to bottom of well.

4.2.5. A water-level indicator will be used for measurement. Due to possible pressure differences between the well atmosphere and the ambient atmosphere, the water level will be allowed to equilibrate for 15 minutes following removal of the well cap. The results shall be recorded in the appropriate location(s) on the appropriate field forms.

4.2.6. Total depth measurements will be compared to original depths to determine the degree of siltation that may have occurred. This information shall be noted on the field form. Should significant siltation occur in any well, the well may need to be redeveloped by an approved method. This information will also be used to confirm that the proper well is being sampled (in case of cluster wells).

4.2.7. The portion of the tape immersed in the well shall be decontaminated during retrieval using a distilled water rinse followed by drying with a clean wipe, prior to use in another well. This decontamination procedure shall be amended, as needed, to accommodate the specific type of contamination anticipated.

4.3. Field Analysis

4.3.1. Parameters that are physically or chemically unstable shall be measured immediately after collection using a field test meter or other equipment. Parameters such as pH, temperature, specific conductivity, and turbidity will be measured in the field, at the temperature of the well sample. The measurement of additional parameters may be required dependent upon sampling methods or other site-specific conditions.

4.3.2. A combination of pH/temperature/specific conductivity meters shall be used. The meter shall be calibrated prior to use and at the end of the day using calibration solutions, in accordance with the instructions provided in the instrument's operating manual. Whenever a



questionable reading ("spike") is observed the calibration shall be checked. The calibration shall be checked prior to sampling each well or well cluster. Calibration information to be recorded in the field paperwork shall include the temperature, pH, and conductivity readings in each calibration solution before and after each calibration.

The pH/temperature/conductivity meters shall be placed into a sample and allowed to stabilize for a minimum of twenty seconds. The accuracy of measurement shall be 0.1 standard units for pH, and 0.1° Celsius for temperature. For conductivity, the accuracy shall be as stipulated by the range of the instrument. The sample shall be discarded in an appropriate manner upon completion of the analysis.

4.3.3. The pH/temperature/specific conductivity meters shall be decontaminated using a distilled/deionized water rinse between each sample. To the extent possible, the same probe and meter shall be used for all measurements at a given site for the duration of monitoring at the site.

4.3.4. Turbidity of the sample will be measured using a DRT turbidimeter, Model 15C or equivalent, that has been calibrated in accordance with the instructions provided in the instrument's manual. The accuracy of the measurement shall be to 1 NTU (nephelometric turbidity unit).

4.4. Well Evacuation

4.4.1. Calculate standing water in the well based on the following schedule and record on the appropriate field form:

Well Diameter (inches)	Conversion Factor (gal/feet)
½	0.01
1	0.041
1 ¼	0.064
1 ½	0.091
2	0.163
4	0.654
6	1.47

4.4.2. Generally, a centrifugal, submersible, air-lift, bladder, inertial, or peristaltic pump equipped with a fluorocarbon resin or PVC foot valve on the end of dedicated tubing, as appropriate, may be used to evacuate the monitoring wells. Alternatively, evacuation of the wells may be accomplished using a bailer.



- 4.4.3. A new sheet of polyethylene plastic shall be placed on the ground adjacent to the well. Sampling and purging equipment, such as pump, tubing, bailers and bailer twine, containers, etc., shall be placed on the polyethylene sheet, never on the ground.
- 4.4.4. Don disposable gloves, prepare pump and tubing for insertion into the well, ensuring that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping. Pumping shall occur within the well screened interval as indicated on the well construction diagram. If the well construction information is not available, the bottom of the tubing or pump shall be placed 1' - 2' above the bottom of the well.
- 4.4.5. Lower the pump and/or tubing gently into the water column to the appropriate depth and begin pumping.
- 4.4.6. Measure pH, temperature, specific conductivity, turbidity and other specific parameters in the well from the first water extracted during the purging process.
- 4.4.7. Remove a volume of water equal to 3 to 5 times the standing water from the well measured into an appropriate container. Purging of the well shall occur at a slow rate to minimize agitation of the water recharging the well.
- 4.4.8. If it is not possible to remove three volumes as described above, due to slow recovery of the well, the well shall be emptied and allowed to recover. In slow-yielding wells, whenever full recovery exceeds two hours, the sample shall be extracted as soon as a sufficient volume is available for a sample for each parameter.
- 4.4.9. Measure pH, temperature, specific conductivity, turbidity and other specific parameters **prior** to sampling.
- 4.4.10. Well evacuation is deemed to be complete when the following criteria have been met:
- pH measurements vary no more than ± 0.5 standard units.
 - Specific conductivity measurements vary no more than $\pm 10\%$.
 - Temperature measurements vary no more than $\pm 1^{\circ}\text{C}$.
 - Turbidity measurements (if used) are below 5 NTU, if practicable.



Alternatively well purging shall be deemed complete if a maximum of five well volumes have been removed from the well and/or other site-specific or method-specific parameters have stabilized.

- 4.4.11. Measure pH, temperature, specific conductivity and turbidity (and other specific parameters) again **after** sampling to determine the effectiveness of purging and sample stability.
- 4.4.12. Do **not** re-use purging equipment (bailers, rope, tubing, sampling vials, etc.). Any non-disposable bailers shall be returned to the office for decontamination. Pumps shall be decontaminated between monitoring wells, in accordance with procedures noted in Section 4.7.
- 4.4.13. Bailer twine and other consumables, such as filter apparatus, shall be disposed of appropriately.
- 4.4.14. Record sampler's name, sampling time, volume of water purged, parameters measured, weather conditions, sample number, analyses required and all other pertinent information on appropriate field forms, and complete the chain of custody form. The field paperwork shall also provide an indication of other field conditions that could potentially impact water levels (such as a pond being drained, or presence of a beaver dam in nearby surface water).
- 4.4.15. As dictated by project-specific requirements and/or groundwater quality considerations, any water purged from the monitoring wells shall be stored in properly labeled containers for disposal.
- 4.4.16. Storage shall be in properly labeled containers approved for storage of hazardous materials, and in an appropriate designated location at the site.

4.5. Sample Withdrawal

- 4.5.1. In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e. agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process. The sample set shall include enough dedicated bailers and sample jars to obtain samples from each well, and additional quality assurance/quality control (QA/QC) samples such as duplicates, trip blanks and equipment blanks. In addition, it is recommended to increase the supply of



sampling equipment and sample jars by about 10% to account for missing or broken glassware.

4.5.2. Use either an appropriate pump or bailer to purge each well (the same pump used for purging may be used for sample withdrawal, with the exception that samples intended for VOC analysis must be collected using either a bailer or a bladder pump.). Do not reuse a bailer in the field; used non-disposable bailers shall be returned to the office for decontamination.

4.5.3. To minimize agitation of the water column, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:

- Extractable organics (semi-volatile).
- Total petroleum hydrocarbons (TPH).
- Poly chlorinated biphenyls (PCBs).
- Metals.
- Phenols.
- Cyanide.
- Chloride and sulfate.
- Nitrate and ammonia.
- Turbidity.
- Radionuclides.

Samples to be analyzed for the following constituents shall be collected using a bailer, after any pump and tubing have been removed from the well. Removal of any down hole equipment shall be done carefully and in a manner that minimizes disturbance of the water column.

- Volatile organic compounds (VOCs).
- Purgeable organic carbon (POCs).
- Purgeable organic halogens (POX).
- Total organic halogens (TOX).
- Total organic carbon (TOC).



- 4.5.4. Samples shall be obtained from the monitoring wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.
- 4.5.5. Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container.
- 4.5.6. Samples collected for dissolved metals analysis, which are to be filtered in the field, shall be passed through a 0.45 micron (maximum) filter (either in-line or under negative pressure) prior to placement in the sample bottle.
- 4.5.7. In situations where replicate samples shall be required, care shall be taken to ensure that each sample collected is independent.
- 4.5.8. In some situations, inorganic parameters may be sampled directly from a pump after completion of well evacuation procedures.
- 4.6. Post Sampling Procedures
 - 4.6.1. As required, upon completion of all sampling procedures for a particular site, secure the lid of the cooler using packaging tape with the chain of custody inside.
 - 4.6.2. If the laboratory is local, transport the samples directly to the laboratory and present them to the sample manager. The representative of LEA should witness the verification of the chain of custody and obtain a carbon copy for filing in the project notebook.
 - 4.6.3. If the laboratory is distant, arrange for transport with a reputable carrier service. Typically, the laboratory specifies the carrier to be used and provides the shipping papers. The cooler and samples shall be secured for transport, and all mailing documentation secured onto the top of the cooler. Unless otherwise specified, delivery shall be overnight. Friday shipments should be mailed for Saturday delivery, once confirmed that the laboratory can accept them on Saturday. The laboratory shall provide confirmation of acceptance noting the temperature of the temperature blank and any deviations from the chain of custody.



4.7. Field Documentation

4.7.1. Field documentation shall include at a minimum: a chain-of-custody form, Field Data Record Groundwater Form, Sample Collection Form, Daily Field Report, Field Quality Review Checklist. Sample labels shall be used for proper sample identification.

4.7.1.1. The labels shall be sufficiently durable to withstand immersion for 48 hours without detaching and to withstand normal handling. The information provided shall be legible at all times.

4.7.1.2. The following information shall be provided on the sample label using an indelible-ink pen:

- Sample identification number.
- LEA Commission Number.
- Date and time of collection.
- Place of collection.
- Parameter(s) requested (if space permits).

4.7.1.3. A field logbook and/or appropriate field forms will be used to log all pertinent information with an indelible-ink pen. The following information shall be provided:

- Project and site identification.
- LEA commission number.
- Identification of well.
- Static water level measurement technique.
- Presence of immiscible layers and detection method.
- Time well purged.
- Collection method for immiscible layers and sample identification numbers.
- Well evacuation procedure/equipment.
- Sample withdrawal procedure/equipment.
- Date and time of collection.



- Types of sample containers used and sample identification numbers.
- Preservative(s) used.
- Parameters requested for analysis.
- Field analysis method(s).
- Whether or not field filtration was performed and the filter size, if appropriate.
- Field observations on day of sampling event.
- Record of site activities.
- Field personnel.
- Climatic conditions, including air temperature.
- Status of total production.
- Record of non-productive time.
- Name of all visitors to the site related to the project.

4.7.1.4. The chain-of-custody record shall include the following information:

- Company's name and location.
- Date and time of collection.
- Sample number.
- Container type, number, size.
- Preservative used.
- Signature of collector.
- Signatures of persons involved in the chain of possession.
- Analyses to be performed.
- Type and number of samples.

A separate entry shall be made for each sample, and within each sample each case that a different preservative is used.



4.7.1.5. The Field Data Record Groundwater Form shall be updated during the sampling of each well and include the following information:

- Identification of well.
- Well depth, diameter, depth to water.
- Static water level depth and measurement technique.
- Purge volume and pumping rate.
- Time well purged.
- LEA commission number.
- Date.

4.8. Equipment Decontamination

All materials and equipment, which enter a well, must be clean and free of any potential contaminants. In general, the equipment and materials entering the well shall be unused and preferably disposable. Any items not considered disposable should be decontaminated prior to commencing field activities. If field decontamination is required, the choice of decontamination procedures shall be based upon knowledge of the site-specific contaminants and as outlined in the site-specific work plan.

For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below shall be followed.

- 4.8.1. Prior to commencing any field activities, the following solutions (as appropriate for the appropriate contaminants) shall be prepared and placed into 500-ml laboratory squirt bottles: 10% methanol in water; 10% nitric acid in water; 100% n-hexane; distilled, de-ionized water.
- 4.8.2. In the field, prepare approximately 2.5 gallons of a solution of Alconox[®] (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.
- 4.8.3. Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting shall be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic shall be bermed to contain spills.
- 4.8.4. The order for decontaminating equipment is as follows:



- 1) Detergent scrub.
- 2) DI water rinse.
- 3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
- 4) DI water rinse.
- 5) 10% nitric acid rinse (to be used only when metals are suspected as potential contaminants).
- 6) DI water rinse.
- 7) Methanol rinse (<10% solution).
- 8) Air dry.

- 4.8.5. Materials considered disposable such as the bailer cord, pump tubing, filters, etc. shall not be decontaminated and shall be disposed of in accordance with all applicable municipal, state, and federal regulations.
- 4.8.6. Wrap each piece of decontaminated equipment in aluminum foil, as appropriate, to maintain cleanliness.
- 4.8.7. At the end of the project day, dispose of all spent decontamination fluids and materials such as the polyethylene sheeting and personal protective equipment in accordance with all applicable municipal, state, and federal regulations.

5. Quality Assurance/Quality Control

Typically samples taken for Quality Assurance/Quality Control for liquid sample collection include duplicate samples, equipment blanks and trip blanks. The necessity for these samples will be outlined in the site-specific work plan. In general, all QA/QC measures taken during liquid sample collection shall be in conformance with LEA's standard operating procedure (SOP) ID 10005. Standard QA/QC measure shall include the recording of pertinent information as follows:

- 5.1. The Field Instrument & Quality Assurance Record, which is a portion of the Daily Field Report, shall include the following information:
 - Instrument make, model, and type.
 - Calibration readings.
 - Calibration/filtration lot numbers.
 - Field personnel and signature.



5.2. The Field Quality Review Checklist, which is a portion of the Daily Field Report, shall assure the completeness of the sampling round and include the following information:

- Reviewer's name and date.
- Review of all necessary site activities and field forms.
- Statement of corrective actions for deficiencies.

6. References

- 6.1. EPA, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER 9950.1, September 1986.
- 6.2. EPA, *Practical Guide for Groundwater Sampling*, EPA/600/2-85/104, September 1985.
- 6.3. DEP, *Site Characterization Guidance Document*, Draft, June 12, 2000.

END OF DOCUMENT



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Low Flow (Low Stress)
Liquid Sample Collection and Field Analysis

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Approved By: <u>/s/ David C. Brisson</u>	<u>12/03/02</u>
David C. Brisson	Date
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REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	06/11/01	
001	04/01/02	Updated to reflect new SOP format.
002	12/02/02	Updated to reflect stabilization procedures.



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
For
Low Flow (Low Stress)
Liquid Sample Collection and Field Analysis

1. Purpose and Scope

This standard operating procedure (SOP) describes the procedures to be followed for measurement of static water level elevations, detection of immiscible layers, well evacuation, sample withdrawal, and field analyses utilizing low flow sampling techniques.

2. Definitions

- 2.1. Immiscible layers: The term is used to denote free-phase liquids that may be present in the aquifer as a result of a release. These liquids may have a density lighter than water (light non-aqueous phase liquids (LNAPL) or floaters) or heavier than water (dense non-aqueous phase liquids (DNAPL) or sinkers).

3. Equipment

- 3.1. Equipment required for the collection and field analysis of liquid samples shall include:
- Water-level indicator (accurate to 0.01 foot).
 - Distilled water.
 - Hand towels.
 - Portable volatile organic compound (VOC) analyzer (Photovac MicroTIP®, Foxboro OVA® or equivalent).
 - Interface probe/ clear view bailer.
 - Flow-through-cell capable of monitoring pH, temperature, specific-conductance, Eh, dissolved oxygen, and turbidity.
 - Polyethylene plastic sheeting.
 - Adjustable rate submersible pump (preferred), adjustable rate centrifugal pump or bladder pump (constructed of stainless steel or Teflon®),



adjustable rate peristaltic pump and polyethylene tubing (1/4 to 3/8 inch inner diameter (I.D.)), or other appropriate pumping apparatus.

- Clean disposable gloves.
- Alconox[®]; or other non-phosphate laboratory grade detergent.
- Three 5-gallon buckets.
- Decontamination brushes.
- Distilled, de-ionized (DI) water.
- Decontamination fluids (less than 10 percent methanol in water, 100 percent n-hexane, and 10 percent nitric acid).

4. Procedure

4.1. Equipment Decontamination

All materials and equipment, which enter a well, must be clean and free of any potential contaminants. In general, the choice of decontamination procedures should be based upon knowledge of the site-specific contaminants and outlined in the site-specific work plan.

For sites at which the contaminants are unknown, but contamination is suspected, the decontamination procedures outlined below should be followed.

- 4.1.1. Prior to commencing any field activities, the following solutions (as appropriate for the appropriate contaminants) should be prepared and placed into 500-ml laboratory squirt bottles: less than 10 percent methanol in water; 10 percent nitric acid in water; 100 percent n-hexane; distilled, de-ionized water.
- 4.1.2. In the field, prepare approximately 2.5 gallons of a solution of Alconox[®] (or other suitable non-phosphate laboratory grade detergent) in tap water in a 5-gallon bucket.
- 4.1.3. Prepare a piece of 5-mil polyethylene sheeting to underlie the decontamination area. The sheeting should be of sufficient size to contain any accidental discharge of decontamination solutions. The plastic should be bermed to contain spills.
- 4.1.4. The order for decontaminating equipment is as follows:

- 1) Detergent scrub.



- 2) DI water rinse.
- 3) Hexane rinse (to be used only if separate-phase petroleum product, other than gasoline, is present).
- 4) DI water rinse.
- 5) 10 percent nitric acid rinse (to be used only when metals are suspected as potential contaminants).
- 6) DI water rinse.
- 7) Methanol rinse (less than 10 percent solution).
- 8) Air dry.

4.1.5. Materials such as the bailer cord should not be decontaminated and should just be disposed of after each test.

4.1.6. Wrap each piece of decontaminated equipment in aluminum foil, as appropriate, to maintain cleanliness.

4.1.7. At the end of the project day, dispose of all spent decontamination fluids and materials such as the polyethylene sheeting and personal protective equipment in accordance with all applicable municipal, state, and federal regulations.

4.2. Sample Collection

4.2.1. Immediately upon opening the well, the air in the well head will be sampled for VOCs using a portable VOC analyzer, such as a Photovac MicroTIP® or equivalent. The instrument shall be zeroed with ambient air prior to the measurement, and the initial and final readings shall be recorded for each well.

4.3. Detection of Immiscible Layers

4.3.1. Should evidence warrant, a sampling event shall include provisions for detection of immiscible phases prior to well evacuation or sample collection. LNAPLs are relatively insoluble liquid organic compounds with densities less than that of water (1 g/ml), while DNAPLs are organic compounds with densities greater than that of water. Lighter and/or denser immiscible phases may be encountered in a groundwater monitoring well.

4.3.2. An interface probe will be used to determine the existence of any immiscible layers, light or dense. Alternatively, a clear fluorocarbon resin or PVC bailer may be used to determine the existence of the



phases or oil sheen in the well when no accurate determination of the immiscible layer thickness is required.

- 4.3.3. Should elevations of the immiscible layers be required, levels of the fluids shall be measured to an accuracy of 0.02 feet using an electronic interface probe capable of detecting the interfaces between air, product, and water. The interface levels shall be recorded in the field form. Adjustments of the observed head to the theoretical hydraulic head shall be calculated based on the density conversion factor associated with the particular non-aqueous phase liquid.
- 4.3.4. If immiscible layers are detected low-flow sampling is not recommended.

4.4. Measurement of Static Water Level

- 4.4.1. The static water elevations in each well shall be measured prior to each sampling event. This is performed initially to characterize the site, and in subsequent sampling rounds to determine whether horizontal or vertical flow gradients have changed. A change in hydrologic conditions may necessitate modification of the groundwater monitoring program.
- 4.4.2. Remove the protective cover and locking cap from the well.
- 4.4.3. Each well shall have a surveyed reference point located at the top of the well casing with the locking cap removed. The reference point shall be easily recognizable, since the personnel conducting the sampling may differ from one sampling event to the next.
- 4.4.4. The following parameters shall be measured with an accuracy of 0.01 ft:
 - Depth to standing water.
 - Depth to bottom of well.
- 4.4.5. A water-level indicator with a fiberglass tape will be used for measurement. Due to possible pressure differences between the well atmosphere and the ambient atmosphere, the water level will be allowed fifteen minutes to equilibrate upon removal of the well cap. If excess pressure is encountered the water level will be allowed greater



than fifteen minutes to equilibrate upon removal of the well cap. The results shall be recorded on the appropriate field form(s).

- 4.4.6. Total depth measurements will be compared to original depths to determine the degree of siltation that may have occurred. This information shall be noted on the field forms. Should significant siltation occur in any well, the well shall be redeveloped by an approved method.
- 4.4.7. The portion of the tape immersed in the well shall be decontaminated during retrieval using a distilled water rinse followed by drying with a clean wipe, prior to use in another well. This decontamination procedure shall be amended, as needed, to accommodate the specific type of contamination anticipated.
- 4.4.8. The static water level should be monitored and recorded throughout the purging and sampling of each well.

4.5. Field Analysis

- 4.5.1. Parameters that are physically or chemically unstable shall be tested utilizing a flow-through-cell. Such parameters as pH, temperature, specific conductance, dissolved oxygen (DO), oxidation reduction potential (Eh), and turbidity will be measured in the field, at the temperature of the well sample.
- 4.5.2. Parameters such as pH, temperature, specific conductance, DO, Eh, and turbidity shall be measured using a flow-through-cell (YSI model 6820 or equivalent). The meter shall be calibrated prior to use and at the end of the day using supplied solutions, in accordance with the instructions provided by the manufacturer. Calibration information will be recorded in the field before and after each calibration.

4.6. Well Evacuation

- 4.6.1. Calculate standing water in the well based on the following schedule and record on the appropriate field form:



Well Diameter (inches)	Conversion Factor (gal/feet)
2	0.163
4	0.654
6	1.47

- 4.6.2. Generally, a submersible, air-lift, bladder, inertial, or peristaltic pump equipped with a fluorocarbon resin or PVC foot valve on the end of dedicated tubing, as appropriate, may be used to evacuate the monitoring wells.
- 4.6.3. A new piece of polyethylene plastic shall be placed on the ground adjacent to the well. Sampling and purging equipment, such as pump, tubing, containers, etc., shall be placed on the polyethylene sheet, never on the ground.
- 4.6.4. Don disposable gloves, prepare pump and tubing for insertion into the well, ensuring that any tubing or pump apparatus is of sufficient length to reach the appropriate depth for pumping.
- 4.6.5. Lower the pump and/or tubing gently into the water column to the midpoint of the zone to be sampled. A site-specific sampling plan should specify the sampling depth, or provide specific criteria for the selection of intake depth for each well. If possible keep the pump intake two feet above the bottom of the well. Start the pump at the lowest speed setting and slowly increase the speed until discharge occurs. Check the water level. Adjust the pump rate until little or no draw down occurs. Draw down should not exceed 0.3 feet, if the draw down exceeds 0.3 feet shut the pump down and allow to recharge. Alternate pumping and recharging until parameters stabilize. It should be noted that stable drawdowns of 0.3 feet while desirable are not mandatory.
- 4.6.6. Monitor and record water level and pumping rate every three to five minutes during purging. Calculate the volume of the discharge tubing, bladder pump, and the flow-through-cell. Once this volume has been purged from the well monitor and record indicator field parameters (turbidity, pH, Eh, DO, temperature and specific conductance) in the well from the first water extracted during the purging process and three consecutive samples taken every three to five minutes. Stabilization is considered to be achieved when three consecutive readings are within the following limits:



- Turbidity (10% for values less than 5 and greater than 1 NTU).
It should be noted that achievements of turbidity levels less than 5 NTUs are not mandatory but efforts should be made to collect a groundwater samples with the lowest turbidity achievable.
- DO (10%).
- Specific Conductance and Temperature (3%).
- pH (+/- 0.1 unit).
- ORP/Eh (+/- millivolts).

- 4.6.7. If it is not possible to obtain stabilization as described above, due to slow recovery of the well, the well shall be emptied and allowed to recover, or if after 4 hours of purging the field parameters have not stabilized, discontinue purging and collect samples. Make special note on the appropriate sampling forms that sample collection occurred without stabilization. Samples obtained from slow-yielding wells shall be extracted as soon as a sufficient volume is available for a sample for each parameter.
- 4.6.8. Measure indicator parameters again **after** sampling to determine effectiveness of purging and sample stability.
- 4.6.9. Do **not** re-use purging equipment (bailers, rope, tubing, sampling vials, etc.). Pumps shall be decontaminated between monitoring wells, in accordance with procedures noted in Section 4.1.
- 4.6.10. Record sampler's name, sampling time, volume of water purged, parameters measured, weather conditions, sample number, analyses required and all other pertinent information in the field notebook and/or appropriate field forms, and complete the chain of custody form.
- 4.6.11. Any water purged from the monitoring wells shall be stored in appropriate containers until the laboratory analyses are available. Then it should be disposed of in accordance with all applicable local, state and federal requirements.
- 4.6.12. Storage shall be in containers approved for storage of hazardous materials, and in an appropriate designated location at the facility.



4.7. Sample Withdrawal

- 4.7.1. In order to ensure that the groundwater sample is representative of the formation, it is important to minimize physical alteration (i.e. agitation during purging and/or sample collection) or chemical contamination of the sample during the withdrawal process.
- 4.7.2. Use an appropriate pump to purge each well (the same pump used for purging may be used for sample withdrawal, with the exception that samples intended for VOC analysis must be collected using a bladder pump).
- 4.7.3. The samples shall be collected at a location before entering the flow-through-cell. To minimize agitation of the water column, samples shall be collected from the pump tubing in the following order into pre-labeled sample containers:
- Extractable organics (semi-volatile).
 - VOCs.
 - Total petroleum hydrocarbons.
 - PCBs.
 - Metals.
 - Phenols.
 - Cyanide.
 - Chloride and sulfate.
 - Nitrate and ammonia.
 - Turbidity.
 - Radionuclides.
 - Purgeable organic carbon (POCs).
 - Purgeable organic halogens (POX).
 - Total organic halogens (TOX).
 - Total organic carbon (TOC).
- 4.7.4. Samples shall be obtained from the monitoring wells as soon as possible after purging. This may require waiting an extended period for low-yielding wells.



- 4.7.5. Samples collected for VOC analysis shall be free of any air bubbles and inverted upon filling. Bacterial samples shall be collected using dedicated gloves; taking care not to allow anything to touch the inside of the sampling container.
- 4.7.6. Samples collected for dissolved metals analysis, which are to be filtered in the field, shall be passed through a 0.45 micron (maximum) filter (either in-line or under negative pressure) prior to placement in the sample bottle.
- 4.7.7. In situations where replicate samples are required, care shall be taken to ensure that each sample collected is independent.
- 4.7.8. In some situations, inorganic parameters may be sampled directly from a pump after completion of well evacuation procedures.
- 4.8. Field Documentation
- 4.8.1. Field documentation shall include at a minimum: a chain-of-custody form, Field Data Record Groundwater Form, Sample Collection Form, Daily Field Report. Sample labels and sample seals shall be used for proper sample identification.
- 4.8.1.1. The labels shall be sufficiently durable to withstand immersion for 48 hours without detaching and to withstand normal handling. The information provided shall be legible at all times.
- 4.8.1.2. The following information shall be provided on the sample label using an indelible pen:
- Sample identification number.
 - Date and time of collection.
 - Place of collection.
 - Parameter(s) requested (if space permits).
- 4.8.1.3. Appropriate field forms will be used to log all pertinent information with an indelible pen. The following information shall be provided:
- Project and site identification.
 - LEA commission number.



- Identification of well.
- Static water level measurement technique.
- Presence of immiscible layers and detection method.
- Time well purged.
- Collection method for immiscible layers and sample identification numbers.
- Well evacuation procedure/equipment.
- Sample withdrawal procedure/equipment.
- Date and time of collection.
- Types of sample containers used and sample identification numbers.
- Preservative(s) used.
- Parameters requested for analysis.
- Field analysis method(s).
- Whether or not field filtration was performed and the filter size, if appropriate.
- Field observations on day of sampling event.
- Record of site activities.
- Field personnel.
- Climatic conditions, including air temperature.
- Status of total production.
- Record of non-productive time.

4.8.1.4. The Field Sampling Record shall include at a minimum the following information:

- Identification of well.
- Date and time of collection.
- Name of collector.
- Sample number.



4.8.1.5. The chain-of-custody record shall include the following information:

- Company's name and location.
- Date and time of collection.
- Sample number.
- Container type, number, size.
- Preservative used.
- Signature of collector.
- Signatures of persons involved in the chain of possession.
- Analyses to be performed.
- Type and number of samples.

4.8.1.6. The Field Data Record Groundwater Form shall be updated during the sampling of each well and include the following information:

- Identification of well.
- Well depth, diameter, depth to water.
- Static water level depth and measurement technique.
- Purge volume and pumping rate.
- Time well is purged.
- LEA commission number.
- Date.

4.8.1.7. The Daily Field Record shall include the following information:

- Client's name, location, LEA commission number, date.
- Instrument make, model, and type.
- Calibration readings.
- Calibration/filtration lot numbers.



- Field personnel and signature.

4.8.1.8. The Daily Field Record shall assure the completeness of the sampling round and include the following information:

- Reviewer's name, date, and LEA commission number.
- Review of all necessary site activities and field forms.
- Statement of corrective actions for deficiencies.

5. References

- 5.1. United States Environmental Protection Agency (EPA), Region I. *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*, July 30, 1996, Revision 2.
- 5.2. Robert W. Puls and Michael Barcelona, EPA. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, in Groundwater Issue, (EPA/540/S-95/504), April 1996.
- 5.3. Connecticut Department of Environmental Protection, Bureau of Water Management, Permitting Enforcement and Remediation Division. *Site Characterization Guidance Document*, Draft, June 12, 2000.

END OF DOCUMENT



**Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Activities**

**SOP ID: 10005
Date Initiated: 02/20/90
Revision No. 004: 12/31/01**

Approved By: <u>/s/ Jeffrey J. Loureiro</u>	<u>12/19/01</u>
Jeffrey J. Loureiro	Date
President	
<u>/s/ Nick D. Skoularikis</u>	<u>12/19/01</u>
Nick D. Skoularikis	Date
Director of Quality	

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	02/20/90	
001-003	-	No record.
004	12/31/01	Updated to reflect new SOP format. Added section 4.3, Results Evaluation. Minor revisions throughout.



Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Quality Assurance/Quality Control Measures
for
Field Activities

1. Statement of Purpose

This document describes procedures to be followed for proper Quality Assurance Quality Control (QA/QC) practices which shall incorporate all activities associated with sampling tool and instrument preparation, field measurements and sampling, proper documentation of field and post-field activities, QC sample preparation, chain-of-custody protocol and laboratory analytical procedures. The use of specific QA/QC measures is project-specific as defined in the project work plan. This standard operating procedure (SOP) was adopted in accordance with the Environmental Protection Agency (EPA) document *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846).

2. Definitions

- 2.1. Trip Blank: An aliquot of organic-free water or equivalent neutral reference material carried into the field but not exposed.
- 2.2. Equipment Blank: An aliquot of analyte-free deionized water processed through all sample collection equipment.
- 2.3. Replicate Samples: Samples that have been divided into two or more portions in the field.
- 2.4. Collocated Samples: Independent samples collected under identical circumstances in a way that they are equally representative of the parameter of interest.
- 2.5. Performance Evaluation (PE) Sample: A sample that mimics actual samples in all possible aspects, except that its composition is known to the auditor and unknown to the analyst.

3. Equipment

None



4. Procedure

4.1. General

4.1.1. All QA/QC sample preparation procedures shall be properly documented including:

- Name of person(s) or laboratory involved in sample preparation.
- Reagents used.
- Sample number.
- Analyses required.
- Concentration calculations.
- Accuracy of measurements.
- Number, type, size of containers used.
- Preservation method.
- Date and time of sample preparation.

4.1.2. All information shall be included in the field logbook and/or appropriate field forms, but not necessarily in the chain-of-custody record except as needed for proper sample identification and analysis. Blind sample numbers are being used in order not to disclose the nature of the sample to the laboratory. No information that would identify the sample as a QA/QC sample shall be included in the chain-of-custody record.

4.1.3. At the conclusion of each sampling day, a quality control review shall be conducted using the Field Quality Review Checklist and the Daily Field Report.

4.2. QC Sample Preparation

4.2.1. Trip Blank

4.2.1.1. Contaminated trip blanks may indicate contamination of the samples during the field trip or shipment to the lab, cross-contamination between the samples, contaminated sample vials, or improper handling.

4.2.1.2. Trip blanks shall be used only with samples that are to be analyzed for volatile organic compounds.



4.2.1.3. One trip blank shall be included per shipping container (cooler) carrying sample soil and/or groundwater samples that are to be analyzed for volatile organic compounds

4.2.1.4. Trip blanks are prepared using analyte-free deionized organic-free water prior to field activities associated with the sampling event, usually by the laboratory providing the sampling containers. Each trip blank is placed in a 40-ml glass VOA vial and is carried in the same shipping container as the sample(s). Trip blanks should not be opened at any time during transport.

4.2.2. Equipment Blank

4.2.2.1. The purpose of an equipment/rinsate blank is to determine if decontamination procedures were adequate or if any of the equipment might contribute contaminants to the sample.

4.2.2.2. An equipment blank is prepared by running analyte-free deionized water through all sample collection equipment (bailers, pumps, filters, split-spoon) and placing it in the appropriate sample containers for analysis. If equipment has been decontaminated in the field, the equipment blank shall be collected after decontamination procedures have been performed.

4.2.2.3. Equipment blanks shall be used when sampling surface water, groundwater, soil, and sediment.

4.2.2.4. One equipment blank shall be collected for each sample bottle/preservation technique/analysis procedure per matrix per sampling event, or as otherwise specified in project-specific documents.

4.2.3. Replicate Samples

4.2.3.1. Replicate samples provide precision information on handling, shipping, storage, preparation and laboratory analysis.

4.2.3.2. Replicate samples are samples that have been divided into two or more portions in the field. An example of a replicate sample is two identical sample bottles filled with water from the same bailer retrieval. To ensure homogeneity, the bailer should be emptied into a clean, decontaminated beaker used exclusively



for the purpose and containing sufficient volume for both sample containers, and from that into the sample containers.

4.2.3.3. Replicate samples cannot be used when sampling for volatile organic compounds.

4.2.3.4. One replicate sample shall be obtained for each sample bottle/preservation technique/analysis procedure per sampling event or one out of every 20 samples, unless collocated samples are used (see below), or as otherwise specified in project-specific documents.

4.2.4. Collocated Samples

4.2.4.1. Collocated samples provide precision information on sample acquisition, homogeneity, handling, shipping, storage, preparation and laboratory analysis.

4.2.4.2. Collocated samples are independent samples collected in such a way so that presumably they are equally representative of the parameter of interest. Examples of collocated samples are groundwater samples collected sequentially, soil core samples collected side-by-side, or air samples collected essentially at the same time from the same manifold.

4.2.4.3. Collocated samples are especially useful when sampling for volatile organic compounds, for which replicate samples cannot be used.

4.2.4.4. Collocated samples shall be obtained for each sample bottle/preservation technique/analysis procedure per sampling event or one out of every 20 samples, unless replicate samples are used (see above), or as otherwise specified in project-specific documents.

4.2.5. Split Samples

4.2.5.1. The purpose of split samples is to provide an assessment of the laboratory analytical procedure.

4.2.5.2. Split samples are collocated or replicate samples sent to two (or more) different laboratories.

4.2.5.3. Split samples can be used with any sample media. Split samples can be used in conjunction with spiked samples (see



below). In case contradictory results are obtained from the samples split between different laboratories, the spiked samples can be used to verify the analytical data (provided that the spiked samples were properly prepared and the appropriate documentation is available).

- 4.2.5.4. When used, one split/spiked sample per sample bottle/preservation technique/analysis procedure per sampling event or every 20 samples shall be included, or as specified in project-specific documents.

4.2.6. Spiked Samples

- 4.2.6.1. The purpose of spiked samples is to provide information on the precision of the laboratory analytical procedure. However, besides a wrong preparation, several other sources of error exist such as analyte stability, holding time and interactions with the sample matrix.
- 4.2.6.2. Spiked samples are samples spiked with the contaminants of interest. The compounds used for spiking should be of the same chemical group as the contaminants being investigated, but they do not have to be the exact chemical compounds. Spiking should be carefully designed and performed prior to the field investigations. Field matrix spikes are not generally recommended because of the high level of technical expertise required for proper preparation and documentation.
- 4.2.6.3. Can be used with any sample media, however, liquid matrices are preferred due to uniformity of mixing.
- 4.2.6.4. When used, one split/spiked sample per sample bottle/preservation technique/analysis procedure per sampling event or every 20 samples shall be included, or as otherwise specified in project-specific documents. In order to ensure defensible data, performance evaluation (PE) samples, prepared by an independent vendor, are typically being used. The ordering and handling procedures and record keeping requirements are discussed in Loureiro Engineering Associates, Inc. (LEA's) *SOP for Preparation of PE Samples* (SOP 10030).



4.3. Result Evaluation

4.3.1. The analytical results on QA/QC samples should be evaluated along with the remaining analytical data as follows:

4.3.1.1. No constituents should be detected in the trip blank or equipment blank.

4.3.1.2. The relative percent differences (RPDs) shall be computed for all constituents detected in both duplicate samples used.

The RPD between two measurements (e.g., M1 and M2) is calculated as follows:

$$RPD = \frac{|M1 - M2|}{(M1 + M2)/2} \times 100\%$$

4.3.1.3. Any deviations in the performance evaluation samples shall be brought to the attention of the laboratory. An investigation shall then be performed by the laboratory of the method used, laboratory QA/QC procedures followed, and computations performed. The laboratory shall report the results of their investigation and any corrective actions taken.

5. References

5.1. EPA, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846).

END OF DOCUMENT



**Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Documentation and Integrity
of
Field Sampling Activities**

**SOP ID: 10038
Date Initiated: 04/30/99
Revision No. 002: 08/09/02**

Approved By: /s/ David C. Brisson 08/09/02
David C. Brisson Date
Project Geologist

/s/ Nick Skoularikis 08/09/02
Nick D. Skoularikis Date
Directory of Quality

REVISION RECORD

<u>Rev #</u>	<u>Date</u>	<u>Additions/Deletions/Modifications</u>
Initial Issue	4/30/99	
001	12/31/01	Formatting and minor revisions throughout
002	08/09/02	Added requirement for briefing or written work instructions prior to sampling; Added section on field equipment request and vehicle request; Added section on chain-of-custody form; Added section on cooler integrity and shipment.



**Loureiro Engineering Associates, Inc.
Standard Operating Procedure
for
Documentation
of
Field Sampling Activities**

1. Purpose and Scope

- 1.1. This document describes procedures to be followed for proper documentation of all activities associated with sampling of environmental media, including tool and instrument preparation, field measurements and sampling, quality assurance/quality control (QA/QC) sample preparation, and chain-of-custody protocols. The use of specific documentation procedures depends on the goals of a particular project and should be dictated by the project-specific work plan. This Standard Operating Procedure (SOP) is to be used in conjunction with other Loureiro Engineering Associates, Inc. (LEA) SOPs and guidance for the performance of the associated field sampling activities. This guidance can be provided verbally through a briefing prior to the field activities or through a document such as written work instructions or a project-specific work plan.

2. Definitions

None

3. Equipment

None

4. Procedure

4.1. General

- 4.1.1. Field procedures for which documentation covered under this SOP is required include sampling of soil, groundwater, air, surface water, and sediment, and any other media from which samples are collected, as well as associated activities.

Documentation to be provided will include:



- Summary of daily field activities.
- Sample descriptions.
- Equipment used.
- Analyses required.
- Instrument calibration.
- Waste disposal.

4.1.2. All relevant information shall be included on the appropriate field report forms. However, the chain-of-custody record will include only that information necessary for proper sample identification and analysis.

4.2. Paperwork Preparation and Completion

4.2.1. Obtaining field paperwork

4.2.1.1. Prior to the initial start up of field activities, the Project Manager, or a designee, shall submit the proper site information to the Database Manager. This information shall include: project name, client name, commission and task number, site name, site location, directions to site, personnel requirements, type of activities planned for the site, approximate duration of field activities, sample information, and the project start date.

4.2.1.2. Once the correct information is entered into the database, paperwork may be obtained directly by the field personnel through the database or by requesting preparation of the paperwork from the database manager. This task should be completed 24 to 48 hours prior to the initiation of field activities.

4.2.2. Field Equipment and Vehicle Request

4.2.2.1. A field equipment request form should be prepared and submitted to the field services manager. The field services manager will in turn ensure that all equipment are available and in proper condition for the specific project. A field vehicle should also be requested. The vehicle will be assigned to the field team based on availability.



4.2.3. Field Activities Documentation

- 4.2.3.1. The purpose of field paperwork is to adequately document all field activities. It is important to document field conditions that may have an impact on the field activities, such as weather conditions, physical constraints, nearby construction or dewatering activities (to the extent known).
- 4.2.3.2. All field paperwork must be filled out accurately and be completed in the field before the end of the workday. The only exception is the preparation of performance evaluation (PE) samples, which should be completed in the office after the PE samples have been properly labeled (LEA SOP 10030). Information on equipment and expendable item usage shall be completed during the day, but checked for omissions at the end of the day.
- 4.2.3.3. At the conclusion of each sampling day, the field personnel shall conduct a quality control review before leaving the field, using the Quality Assurance Checklist section of the Daily Field Report.

4.2.4. Chain-of-Custody Form

- 4.2.4.1. Although the chain-of-custody forms vary between laboratories and the analyses requested vary on a project-specific basis, the following information should be provided on the chain-of-custody forms:
 - Specify the LEA seven-digit sample number, date and time of collection, sample matrix, the type of analyses requested, and the preservatives used. For aqueous samples, the information provided should clearly indicate which preservative is used for which analyses. The analytical method requested should be specified.
 - The cooler containing the samples should be labeled with the appropriate identification information. If the sample cooler does not already have an ID assign and attach a new preprinted seven-digit LEA sample label to the cooler.
 - Specify whether an electronic disk deliverable (EDD) or data validation package is required.



- Specify the purchase order number, or for United Technologies Corporation (UTC) projects specify the United Analytical Request Procedure (UARP) number.
- Use the suffix “uf” after the seven-digit LEA sample number to denote unfiltered metal samples, as applicable.

4.2.5. Cooler Integrity and Shipment

- 4.2.5.1. An iced cooler should be available with laboratory-supplied glassware and preservatives. The cooler should contain ice prior to and during sample collection.
- 4.2.5.2. A cooler containing samples should never be left unattended during the sampling day. If the field personnel need to leave the site at any time, they can lock the cooler in the trailer, staging area, or field vehicle. A temporary chain-of custody seal shall be used at that time to ensure the integrity of the samples.
- 4.2.5.3. For projects where an offsite laboratory is being used, the office should be contacted to arrange for cooler shipment. In such cases, the laboratory will provide preprinted air bills for shipment through their preferred carrier or will arrange for direct pickup from the office or from the site.
- 4.2.5.4. When the sampling is completed and the cooler is being prepared for shipment, fresh ice should be placed in the cooler along with a temperature blank. It is important that the cooler has been assigned a cooler ID so that the laboratory can associate the temperature measured with a specific cooler.
- 4.2.5.5. The sample jars should be placed in a plastic bag to avoid direct contact with the water, which may cause the labels to peel off.
- 4.2.5.6. A signed custody seal should be used when sealing the cooler. The date and time should also be recorded on the seal.



4.2.6. Post Field Activities

- 4.2.6.1. Ensure that the paperwork is complete and that the pages are numbered sequentially.
- 4.2.6.2. Verify that all waste container information has been recorded.
- 4.2.6.3. Appropriate entries should be made for all visitors to the site related to the field activities performed.
- 4.2.6.4. Document on the field forms, whether any photos of the site were taken.
- 4.2.6.5. Upon completion of the daily field activities and after review of the completed paperwork, a copy of the field paperwork shall be submitted to the database manager. The originals shall be retained for filing in the project notebook.
- 4.2.6.6. All required information from the field is entered into the database by the database manager or a designee. A data review checklist is printed out upon completion. Included with the data review checklist may be a comment sheet indicating inconsistencies in the data entered that were readily apparent based on electronic comparison of the data or noted by personnel entering the data.

4.3. Data Verification

- 4.3.1. The data review checklist and the comment sheet shall be obtained from the database manager by the project manager or a designee for review. The data review checklist shall be maintained in the project notebook under the QA/QC section and will be periodically reviewed by the Director of Quality.
- 4.3.2. Once the project manager or designee completes the review process, any mistakes shall be brought to the attention of the database manager in a timely manner, generally in less than two business days from the day on which the database manager prepared the review sheets.
- 4.3.3. After the corrected information has been entered into the database, a revised data review checklist (and any necessary additional comment sheets) will be provided to the project manager or designee.



- 4.3.4. The above process will be repeated as necessary until it has been determined that the information that has been entered into the database is accurate and complete.

5. References

None

END OF DOCUMENT



APPENDIX B

DATA MANAGEMENT DOCUMENTATION

LEA Procedure for Entering and Verifying Electronic Analytical Data

- 1) Load data into LEA IMS (either with disk or electronic file)
- 2) The LEA IMS database will create 5 tables as follows:
 - a. Sample Summary
 - b. Possible exceedances of CT reporting criteria for significant environmental hazards (conservative comparison)
 - c. Analytical Results
 - d. Analytes Over Detection Limits (conservative comparison)
 - e. Performance Evaluation Check (if PE samples are applicable)
- 3) Each of the tables must be printed and verified for accuracy or evaluated, as follows:
 - a. Sample Summary – verify field sample location, sample ID, sample interval (if applicable), and sample date are correct based on field paperwork
 - b. Possible exceedances – provide information to PM/key office staff person for evaluation against applicable criteria and reporting requirements
 - c. Analytical Results – 1) verify agreement with chain-of-custody (i.e. check that parameters and constituents were analyzed and reported as requested); 2) verify hardcopy analytical data reports versus electronic deliverable and field paperwork
 - d. Analytes Over Detection Limits – provide information to PM/key office staff person for evaluation against applicable standards
 - e. Performance Evaluation Check – verify information from database (PE check sheet against vendor certified ranges and laboratory hardcopy data).
- 4) The attached checklist must be used to document that each of the applicable components of the data verification are complete. Any errors or non-conformances that are noted during the review must be corrected before the corresponding item is noted as completed on the checklist.
- 5) Once complete (i.e. data verification performed and corrections made), the completed checklist must be placed in the project file as the record documenting the data was verified.

Date: June 2001

Documentation for Verifying Electronic Analytical Data

Commission No.:	
Date Electronic Data Recv'd:	
Verification Date:	
Verification Completed by:	
LEA Sample Ids Verified:	
Sample Date:	

LEA IMS Table	Required Verification	Check if Completed
Sample Summary	Verify field sample locations	
	Verify sample IDs	
	Verify Sample Dates	
Possible exceedances	Provide information to PM/key office staff person for evaluation against reporting requirements	
Analytical Results	Verify agreement with COC (i.e. check that parameters and constituents were analyzed and reported as requested)	
	Verify hardcopy analytical data reports versus electronic deliverable, including: <ul style="list-style-type: none"> Data Units Qualifiers Sample Media/Description (verify hardcopy) Commission # (verify hardcopy) Site/Client Source (verify hardcopy) 	
Analytes Over Detection Limits	Provide information to PM/key office staff person for evaluation against applicable standards	
Performance Evaluation Check (if applicable)	Verify information from database (PE check sheet against vendor certified ranges and laboratory hardcopy data).	

Notes/Comments:

copy: Project File
 Project Manager

**LOUREIRO ENGINEERING ASSOCIATES, INC.
DATA MANAGEMENT PLAN**

**January 1991
Revised November 1996
Revised February 2003**

**Prepared by
LOUREIRO ENGINEERING ASSOCIATES, INC.
100 Northwest Drive
Plainville, Connecticut**

An Employee Owned Company

Comm. No. 100

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1. DATA MANAGEMENT PLAN

1.1 Introduction

Since a large volume of data is generated during each project at Loureiro Engineering Associates, Inc. (LEA), it is necessary to develop a company-wide Standard Operating Procedure (SOP for data management to ensure the completeness and integrity of all data associated with the program. Information provided in this data management plan addresses the documentation, tracking, and manipulation of data collected during each project. This data management plan identifies the data documentation materials and procedures, and project filing requirements. Given the number and variety of data being collected during our site investigations/remediation projects, it is imperative that the procedures for handling data from the collection to the reporting phase be clearly outlined and documented.

This data management plan identifies the categories of personnel involved in the data management process, the types of activities associated with data management and how those activities are performed, the chronology and flow of data management activities, and the methods and locations for data storage and reporting.

1.2 Data Management System

1.2.1 Types of Data

Many types of data are being generated and managed during our site investigation/remediation projects. Included in the data management process are analytical data collected during field activities (such as measurements of pH, specific conductance, and temperature of groundwater during groundwater sampling events); information related to sample collection (such as location I.D., sample number, sample depth, date and time of sample collection, analyses to be performed); analytical results from screening or field laboratory; analytical results from the fixed laboratory(ies), survey data of sampling locations; and geologic and hydrogeologic data (such as boring logs, well construction diagrams, and water level elevations). These data shall be included in the appropriate electronic data tables for the type of information generated, and will be managed in accordance with the protocols identified in the appropriate subsections of this Data Management Plan. Management procedures for hard copies of the information generated during each project are also identified in relevant subsections of this plan.



1.2.2 Data Storage

Data are maintained in an electronic database. All sampling and analytical information, as well as survey data, boring logs, and miscellaneous data are maintained in LEA's database, a fully relational database management system. Data maintained in this system include but are not necessarily limited to, sampling location information, including name and spatial/survey information, boring logs, well construction diagrams; sample information including depth of sample, sample collection date, responsible field person, sample identification number, results of field measurements; initial laboratory information including chain-of-custody information and analytical requests; and analytical information, including analyte, analysis dates, and results. This system also contains historical information to the extent it is available.

Paper copies of the various field forms and laboratory reports are organized and maintained in a separate filing system, as appropriate for each type of data. Incoming data are logged in both the project analytical database and on hardcopy. The hardcopy is then placed in the appropriate project file. Analytical results from the laboratories are associated with the sample identification numbers assigned during sample collection. Field log books are also kept as part of the project file and considered to be original documents.

Original field notebooks, log sheets, and other information are transferred from the project file to a designated archive location upon the completion of the project. Chemical and physical data generated during the site investigation are stored in paper document form. In addition, computerized data are stored in electronic back-up formats.

1.2.3 Data Management Process

The actual management of data collected during each project is only part of the larger process of sampling design; sample collection; acquisition of analytical data; data retrieval, storage, and presentation; and data evaluation. A schematic diagram illustrating the data management process and how it fits into the overall investigation process is presented in Figure 1. This figure outlines the flow of data from planning stages through collection and analysis to final output and storage. The data management process itself essentially consists of those activities associated with recording, processing, linking, distributing, and reporting of data.

The protocols outlined within this Data Management Plan have been prepared to ensure the accurate capture and retrieval of data needed to achieve the objectives of the project. These protocols ensure that, for each data collection activity, data can be readily incorporated into the appropriate database, correlated with information from other databases and other aspects of the project, and subsequently reported and presented in a variety of formats.



The earliest steps (1-6) in the Data Flow Diagram identify naming conventions to enable database retrieval consistency. These conventions are identified during preparation of the sampling and analysis plans for each project. The Data Management Plan maintains sample integrity through the sample tracking activities highlighted as steps 5, 6, 8, 10, 12, 15, 16, and 17. Field sampling is represented by steps 10 and 11. Data management protocols addressing submittals to and from analytical laboratories are shown in steps 7, 9, 12, and 13. The database manager processes data from field teams in steps 16, 19, 20, and 22. Data verification activities for analytical results incorporated into the analytical database are shown in steps 16 and 17. The spatial and field data will be processed in the independent streams depicted in the data flow diagram by steps 19, 22, and 24. The analytical data is processed in steps 15, 16, 17, and 21. Various data evaluation activities are identified in steps 23, 25, 26, and 27. Archiving is represented in steps 18 and 28.

1.3 Data Management Activities

1.3.1 Data Management Team

The data management team typically consists of the data manager(s), project managers, technical task leaders, field team leaders, field investigation teams, and laboratory contact personnel. The project manager provides guidance and oversight for data management activities.

1.3.2 Data Management Tasks

The data management team will perform the tasks identified in the following paragraphs. The individuals involved with each task will be project specific and will depend on the size and scope of each project.

Data coordination tasks associated with sampling, analysis and field activities include:

- Logging of incoming data and reports into the project file both on the electronic tracking system and hard copy, as appropriate.
- Entering and verifying field data and generating reports.
- Coordination of analytical and field data.
- Tracking chains-of-custody and field screening results.
- Tracking shipment of samples to the off-site laboratory.
- Tracking samples and electronic deliverables from the off-site laboratories.
- Verifying analytical data from off-site laboratories using appropriate protocols.

Tasks associated with database management specifically include:



- Coordinating data preparation, data loading, and data verification for the database;
- Working with project staff to develop schedules for delivery of analytical results;
- Entering and verifying data in the database; and,
- Coordinating with technical task leaders to ensure efficient delivery and presentation of data.

Specific activities associated with various data management tasks are summarized in the following sub-sections.

1.3.2.1 Data Inputs

Field Measurements

Field measurements include physical data (e.g. pH, temperature, specific conductance, turbidity) collected during investigation activities. Measurements will be recorded in the field and transferred manually from the field data sheets to the electronic analytical database. Data from the database will then be verified against the hardcopy field data sheets.

Onsite Analytical Measurements

Analytical measurements determined using a portable gas chromatograph either at the site or at the screening laboratory are reported in both hard-copy and electronic formats. The electronic data is transferred to the analytical database, and the results from that database are verified against the paper copy laboratory reports.

Off-site Analytical Measurements

Off-site analytical measurements are generated by an off-site (fixed) analytical laboratory. These analytical results are typically delivered in both paper copy and electronic formats and are sent to the database manager for incorporation into the analytical database.

Soil Boring and Well Construction Data

Soil boring and well construction data are included in the geologic/hydrogeologic database for the program. Boring logs include such information as lithology, results of standard penetration tests (if appropriate), sample collection information, and VOC screening results. A monitoring well construction diagram is provided for each monitoring well installed during the project.

Survey Data

Surveying of well and boring locations and selected site features may be performed as part of the site characterization process. Tape measurements may be used for locating boring logs. All



survey information is included in the AutoCAD® base drawing for each project site. This information is also used to locate sampling points and other pertinent features on the AutoCAD®-generated drawings that are produced as the base maps for each facility. Survey/spatial data is also stored in the LEA database.

1.3.2.2 Field Sample Tracking

Field sample tracking activities focus on the timely tracking of information regarding field samples collected for each investigation. Other information tracked includes sample identifiers, chain-of-custody information, and sample characteristics. The information is transmitted from field to office personnel through the use of daily field summary sheets and other project information tracking forms.

Samples collected during the project are designated as described below. In general, sample identification information includes the following:

- Site location.
- Date and time.
- Sample class.
- Sample type.
- Sample location identifier.
- Sequential sample number.
- Sample depth interval (where applicable).

Specifically, field sample tracking includes the following tasks:

- Assignment of sample identification numbers and other sample identifiers to new samples to be taken, and entry to a tracking system.
- Production of sample bottle labels from the tracking system.
- Completion of chain-of-custody forms, and entry of this information to the tracking system.
- Entry of additional tracking dates to the tracking system.
- Quality Assurance (QA) checking of the sample tracking information, and processing of change requests.
- Production of tracking reports and summary sheets, with distribution to appropriate project staff.

Daily field forms are completed by each field team leader. The daily field forms detail the daily activities conducted by the staff and contractors, hours logged by staff and contractors, problems

encountered, general field observations, and samples submitted for analyses. Field forms are submitted to the Field Activities Coordinator at the end of each working day or as soon thereafter as possible. The field forms are subsequently placed in the project file.

The field activities coordinator for each project works closely with the specific project manager to ensure that the sample tracking system is functioning at all times.

1.3.2.3 Data Entry and Storage

The electronic analytical database is maintained in a format that is capable of performing the requisite management functions that are described in the following paragraphs.

Database Administration

Database administration includes coordination of data entry and verification and review of data for completeness and correctness. The database manager interfaces with the project manager, task leaders, and field personnel to ensure that the database meets the project objectives.

Electronic Data Entry

Data received from off-site analytical laboratories in electronic format is checked for completeness by comparing data received with data analyses requested in the chain-of-custody forms. Electronic files are logged in, checked to see that the files received match the transmittal paperwork, copied, and archived in the project files.

The electronic data files are downloaded into the LEA database; this downloading process is typically being conducted by the database manager. The data from the download is printed for review during the data verification process. In addition, standard queries are being generated automatically to allow the investigator: (1) to assess that the detection limits have been adequate to allow comparisons to regulatory criteria; (2) to confirm that the holding times have not been exceeded; and (3) to confirm that the Connecticut notification requirements¹ have not been triggered.

During data verification, printouts of the data received in electronic format are compared with paper copies of the original laboratory reports. In addition, the sample identification number, location, constituent, and qualifier codes are verified.

¹ Reporting of certain Environmental Hazards (Public Act 98-134)



Manual Data Entry

Manual data entry will be performed for any analytical data and physical data that is not received in electronic format. The unverified data is manually entered into the analytical database with results marked as "not verified". Following data verification, the electronic data will be flagged as "verified."

Verification of manually entered data will be performed using the following procedures:

- A listing will be produced of data entered to serve as a checkprint.
- Each record entered into the database will be compared to original coded sheets; correct values will be highlighted, and incorrect values will be marked with revisions in red. The first page of each data listing will be signed and dated by the person completing the comparison.
- Corrections will be made to the database.
- Listings will be produced of data corrected, and the comparison will be repeated (only to corrected values). This procedure will be repeated until corrections are completed.

Archiving of Data

Back up of the electronic database files is being routinely accomplished. Data is backed up on a weekly basis. Data is archived at the conclusion of the project, and the files are maintained in designated locations.

1.3.2.4 Data Presentation

The objective of data presentation is to illustrate the analytical and geologic/hydrogeologic data for each site in formats that facilitate data interpretation. These formats may include tables, figures and drawings, as appropriate.

Analytical Data Presentation

Two types of analytical data presentation are provided: final tables that are generated in a format designed for inclusion in a report, and working tables that are generated for specific uses by the various project personnel. Most queries are being performed by the individual investigators. However, more complex queries can be submitted to the data manager in a written format, with clear instructions as to the type of output requested.

Examples of tables to be created include:

- Appendix-style (tabular listings sorted by location and sample ID).
- Summary of detected values to be included in the final characterization report.
- Site information including measurements of water-table elevation and sample/station location coordinates.
- Analytical data including constituents of concern, analyte concentrations, and qualifiers.
- Exceedances of state and/or federal regulatory criteria.
- Statistical analysis of results.

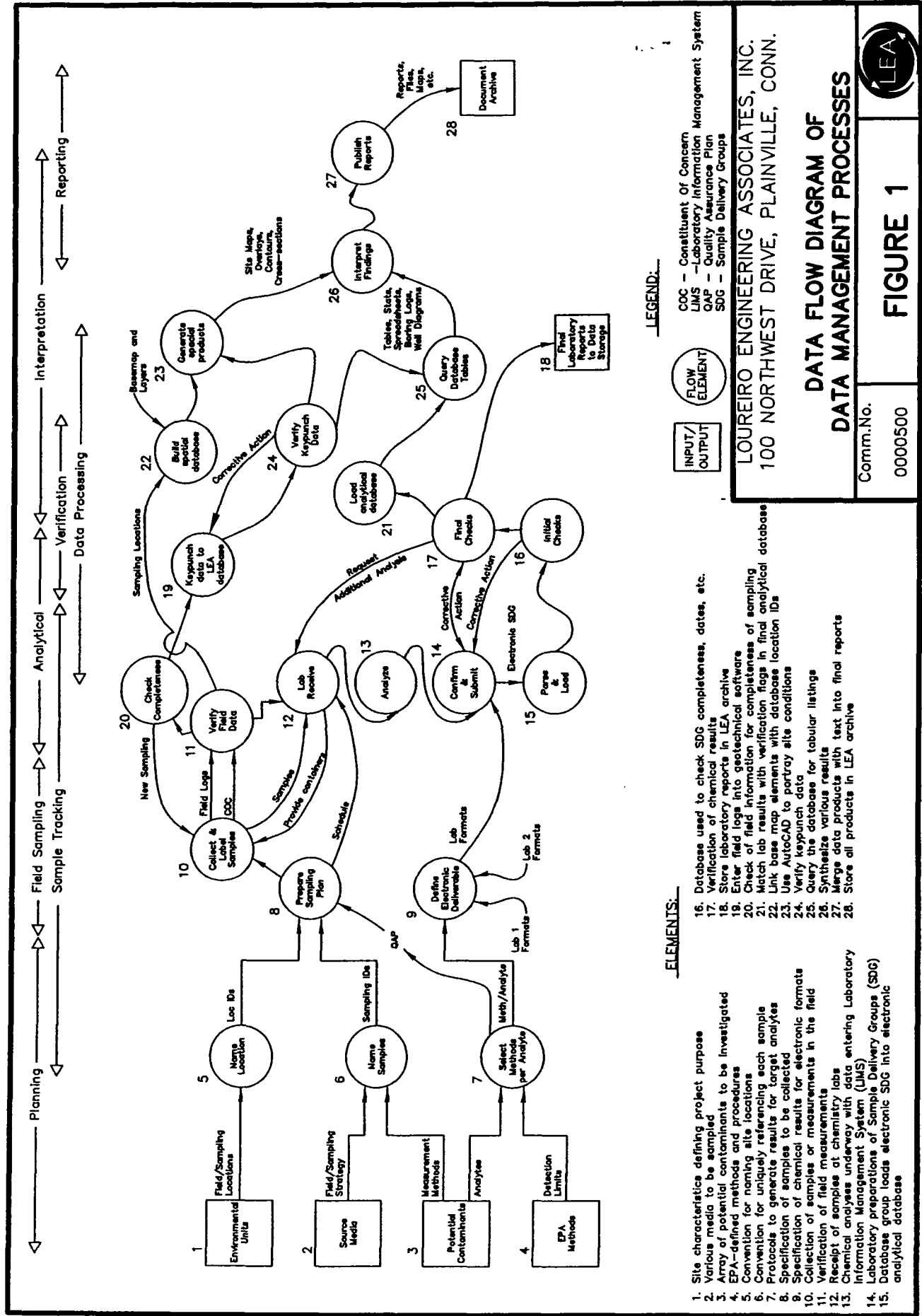
Graphical Data Presentation

Facility base maps can be created using information stored in AutoCAD®. That base map, which is generated from information derived from a variety of sources, is used as the base for all computer-generated drawings of the facilities. Types of maps and drawings that are used to present data or facility information include:

- Soil and groundwater sampling locations. The analytical data can be entered into the drawings as data blocks which can also point out the exceedances over applicable regulatory criteria. The transfer of the data block information from the LEA database to the AutoCAD® system is being done electronically and is independently verified.
- Locations of pertinent environmental units and facility features.
- Water-table and piezometric surface contour maps.
- Maps showing the distribution of contaminant concentrations.

Information from the AutoCAD® database, including surveyed elevation data, coupled with information from the geologic boring logs and well completion information, will be used to generate geologic cross-sections for each of the sites.





APPENDIX C

FIELD FORMS

DAILY FIELD REPORT

Loureiro Engineering Associates, Inc.

Page _____ of _____
Date / /

Project	0000100.001
Location	Farrel Ansonia
Client	LEA, Plainville, CT
	William Jayson

Arrived at Site

Departed from Site

Vehicle

Site Activities

Odometer (Start)

Return

- | | |
|--|------------------------|
| | Soil Sampling |
| | Groundwater Sampling |
| | Surface Water Sampling |
| | Surface Water Sampling |
| | Vapor/Air Sampling |
| | Concrete Sampling |
| | Other Sampling |
| | Well Installation |
| | Well Development |

- | | |
|--|------------------|
| | Geoprobe Work |
| | Concrete Coring |
| | Construction |
| | Inspection |
| | Waste Management |
| | Waste Management |
| | Site Walk Over |
| | Surveying |
| | Other (Describe) |

Current Project Information

Last Sample Number Used

Last Location ID Used

Current Location (if not complete)

Sampling for

Laboratories used

Paperwork & Equipment left at/in

Site Contact

Contractors on Site

Non-productive Time

- | | |
|--|---------------------|
| | None |
| | Equipment Breakdown |
| | Late |

- | | |
|--------------------------|-------------------|
| <input type="checkbox"/> | Weather |
| <input type="checkbox"/> | Missing Equipment |
| <input type="checkbox"/> | Other (Describe) |

Time and place to meet contractors

Quality Assurance Checks

Yes N/A No

	Sample labels complete
	Sample/cooler seals OK
	All samples obtained
	Chains of custody
	All forms/logs complete
	Site walkover
	Site H&S Plan on site
	Instruments calibrated

Instrument Calibrations

pH/Conductivity

Std. Standard Meter

- | | | |
|--|-------|--|
| | pH 4 | |
| | pH 7 | |
| | pH 10 | |
| | Cond. | |

Residuals Disposition

Item	Approx. Amount	Container ID
------	----------------	--------------

Soil/Solid		
Groundwater		
Decon Fluid		
PPE		
Other		

PID/FID Meter

Std. Standard Meter

- | | |
|--|-------------------|
| | Zero w/Background |
| | Zero w/Clean Air |

Balance

Std. Standard Reading

Std. Mass

Expendable Items Used

Qty	Item	LEA Number	Qty	Item	LEA Number
	Bailer, Disposable (spec. size)	090		Automatic Level, Sokkisha	999
	Cap, PVC, 1", (Threaded or FJT)	147		Balance, Ohaus	031
	Cap, PVC, 1', Slip (S447010)	146		Balance, Pocket Pro	061
	Coliwasa Disposable Sample Tubes	204		Bucket w/ Lid, 5 gallon	999
	Concrete, 60 lb. Bag	085		Digital Camera	999
	Decontamination Supplies	081		Drill, Core Saw, w/ Attachment	009
	Drum, Closed Top 55 gallon	086		Drill, Hilti, incl. Concrete Anchors	010
	Drum, Open Top 55 Gallon	086		Dump Hopper	193
	Filter, In Line	024		Generator 3500 Watt	153
	Filter, Zap Cap	024		Hand Auger, w/ attachments	013
	Grout mix, bag	237		Locator, Metrotech Pipe	053
	Hub, 1' Wood	999		Locator, Schonstedt Magnetic	999
	Locks, Monitoring Well	155		Meter, Conductivity	022
	Marker Paint	999		Meter, pH/Temp	021
	Miscellaneous Health & Safety Items	060		Miscellaneous Small Tools & Equipment	152
	Plug, Locking, 2"	233		Pallet, Spill	161

Field Personnel

Signature



Supplemental Sheet

[illegible]



Loureiro Engineering Associates, Inc.

FIELD WORK ASSESSMENT PROJECT MANAGER'S REPORT

LEA Comm. No.	0000100.001	Date	__ / __ / __
Project	Farrel Ansonia	Field Personnel	_____
Location	LEA, Plainville, CT		_____
Client	William Jayson		_____
Project Manager	Jeffrey Loureiro		_____

Activites Performed

% Complete

Difficulties

--	--	--

Evaluate Performance

--

Paperwork Complete
and Accurate

Yes / No

If "No", Describe:

--

IDW Properly Managed

Yes / No / NA

If "No", Describe:

--

Client/Site Contact Satisfied

Yes / No

If "No", Describe:

--

SOP's used:

--

Field Audit Performed
Auditor

Yes / No

Signature

DAILY GEOPROBE REPORT

Loureiro Engineering Associates, Inc.

Page _____ of _____
Date ____/____/____

	0000100.001
Project	Farrel Ansonia
Location	LEA, Plainville, CT
Client	William Jayson

Arrived at Site _____ Departed from Site _____

Geoprobe _____

Vehicle Checklist/Condition

Odometer (Start)	Return
------------------	--------

Probe Hours (Start)	Finish
---------------------	--------

OK	Geoprobe	OK	Trailer (if used)
<input type="checkbox"/>	Engine Fluids	<input type="checkbox"/>	Brakes (Incl. battery)
<input type="checkbox"/>	Transmission	<input type="checkbox"/>	Hitch
<input type="checkbox"/>	Brakes (Incl. parking)	<input type="checkbox"/>	Safety Chains
<input type="checkbox"/>	Lights	<input type="checkbox"/>	Lights
<input type="checkbox"/>	Signals	<input type="checkbox"/>	Signals
<input type="checkbox"/>	Tires	<input type="checkbox"/>	Tires
<input type="checkbox"/>	General	<input type="checkbox"/>	General
<input type="checkbox"/>	Other (describe)	<input type="checkbox"/>	Other (Describe)

Equipment Broken/Needing Repair

All checks above must be OK and signed off before leaving in the morning

Signature

Expendable Items Used			Equipment Used		
Qty	Item	LEA Number	Qty	Item	LEA Number
	Bentonite Chips, Bag	089		Exhaust Hose	033
	Bentonite Pellets, Buckets			Miscellaneous Small Tools & Equipment	152
	Cap, End, Vinyl (AT-641K or AT-726K)	150		Probe Rod Jack	119
	Cap, Slip, 0.5" Vinyl (AT-441)	044		Pump, Grout	200
	Cap, Slip, 1" PVC (S447010)	146		Thermo-Anemometer	248
	Cap, Threaded, 1" PVC	147			
	Concrete, 60 lb. Bag	085			
	Connectors, Snap Lock (GW-2030)	210			
	Core Catchers, MC (AT-8531K)	999			
	Decontamination Supplies	081			
	Ear Plugs				
	Filter, In Line	024			
	Liners, LB PETG (AT-825k)	128			
	Liners, MC Acetate	173			
	Liners, MC PETG	173			
	Locks, Monitoring Well	155			
	Miscellaneous Health & Safety Items	060			
	Point, Drive, Exp., SP15 (GW-15)	003			
	Point, Exp. (spec. GW-2040 or GW-445)	002			
	Sand, Filter Pack, Bags	220			
	Tubing, 1/2", NOS	007			
	Water, Distilled	025			
	Well Point, 1" Sch.80 PVC	216			
	Well Protector, Road Box (10581)	014			
	Well Protector, Roadbox, 7"	014			
	Well Protector, Stickup, 4" (10127)	014			
	Well Riser, 0.5" PVC, 5' (GW2050)	228			
	Well Riser, 1" Sch. 80 PVC, 5' (1058CATB	131			
	Well Screen, 1" Sch. 80 PVC, 5' (105810	130			
	Well Screen, Pre-Packed, 3' (GW-2010)	224			

Field Personnel

Signature



Project	0000100.001	Page ____ of ____
Location	Farrel Ansonia	Date ____/____/____
Client	LEA, Plainville, CT	
	William Jayson	

Field Personnel	<i>Signature</i>
_____	_____
_____	_____



Loureiro Engineering Associates, Inc.

FIELD DATA RECORD MONITORING WELL SAMPLE

Project	0000100.001	Page	_____	of	_____
Location	Farrel Ansonia	Date	____/____/____		
Client	LEA, Plainville, CT	Time	____:		
	William Jayson				

Monitoring Well Number _____ Sample Number(s) _____

Field Data and Measurements

Depth of Well _____	Reference Used _____	Longitude _____
Depth to Water _____	PID/FID Reading _____	Latitude _____
Height of Column _____	Interface _____	Yes / No _____ If yes, Depth _____ Lighter / Heavier _____
Well Casing Diameter _____	Material _____	General Condition _____
Protector _____	Road Box / Stickup _____	Casing Secure _____
Ground to Reference _____		Collar Intact _____
Comments _____		Cover Locked _____
		Other (describe) _____

Purging Information

Purge Volume Factors

0.5" - 0.01

1" - 0.041

1.5" - 0.091

2" - 0.16

4" - 0.65

6" - 1.5

Parameter \ Volumes	Initial						Sample
Gallons							
Temp (C)							
pH (SU)							
Spec. Cond. (umhos)							
Turbidity (NTU)							
Other							

Purge Method Peristaltic Pump / Bailer / Inertial Pump / Other (Describe) _____

Waste Container ID _____

Sampling Information

Sampling Method Peristaltic Pump / Bailer / Inertial Pump / Other (Describe) _____

Sample Quality ☐ Clear ☐ Turbid
☐ Colored ☐ Odor
☐ Cloudy ☐ Sheen

Sample Filtered Yes / No _____ If Yes, with what filter? _____
If No, be sure to use the sample labels with a 'uf' suffix, or add the suffix to the sample number, and record the complete number on the Chain of Custody

Field Decontamination? Yes / No _____ If Yes, with what? _____

Cooler ID(s) _____

Additional Comments

Field Personnel _____ Signature _____



Loureiro Engineering Associates, Inc.

FIELD DATA RECORD MONITORING WELL SAMPLE

Project	0000100.001	Page _____ of _____
Location	Farrel Ansonia	Date ____/____/____
Client	LEA, Plainville, CT	Time ____:____
	William Jayson	
Field Personnel _____		Signature _____



LEA Comm. No.	0000100.001
Project	Farrel Ansonia
Location	LEA, Plainville, CT
Client	William Jayson

Page _____ of _____
Date ____/____/____
Time _____ :

Monitoring Well Number	Sample Number(s)
------------------------	------------------

Depth of Well _____	Reference Used _____		
Depth to Water _____	PID/FID Reading _____		
Height of Column _____	Interface Yes / No	If yes, Depth _____	Lighter / Heavier
Well Casing Diameter _____	Material _____	General Condition	OK Bad
Protector Road Box / Stickup		Casing Secure	<input type="checkbox"/> <input type="checkbox"/>
Ground to Reference _____		Collar Intact	<input type="checkbox"/> <input type="checkbox"/>
Comments _____		Cover Locked	<input type="checkbox"/> <input type="checkbox"/>

[illegible]

Development Method Peristaltic Pump / Bailer / Inertial Pump / Other

Field Decontamination?	Yes / No	If Yes, with what?
------------------------	----------	--------------------

Waste Container ID

Field Personnel _____ Signature _____

WELL COMPLETION REPORT

Project: Farrel Ansonia 0000100.001		Start Date	Well ID
Client William Jayson		End Date	
Location LEA			
Drilling Contractor _____		Logged by _____	
Drilling Method _____		Drilling Foreman _____	
Sampling Method _____		Drill Rig _____	
Groundwater Observation		GPS Latitude _____	
Depth _____ at _____ Hours		GPS Longitude _____	

Protector Material _____ Diameter _____ Length _____ Ground _____ Stickup _____ Key # _____ Cover Type _____ Top Seal Top _____ Bottom _____ Material _____ Backfill Top _____ Bottom _____ Material _____ Secondary Sand Top _____ Bottom _____ Size _____ Filter Pack Top _____ Bottom _____ Material _____ Reported depth to bottom of boring _____ Comments _____		Concrete Diameter _____ Concrete Thickness _____ Reference Stickup _____ Description _____ Casing Diameter _____ Material _____ Length _____ Stickup _____ Seal Top _____ Bottom _____ Material _____ Screen Top _____ Bottom _____ Material _____ Diameter _____ Length _____ Slot Size _____ Miscellaneous Materials (Quantity Used/Item) Cement _____ Bentonite Chips _____ Bentonite Pellets _____ Bentonite Powder _____ Grout Weight _____ Filter Pack Sand _____ Capping Sand _____ Well Point _____ Well Plug _____
---	--	--



Signature _____

FIELD SAMPLING RECORD

WELL DEVELOPMENT

Loureiro Engineering Associates, Inc.

Project **0000100.001** Page ____ of ____
 Location **Farrel Ansonia** Date ____/____/____
 Client **LEA, Plainville, CT** Time ____:____
William Jayson

Monitoring Well Number _____ Sample Number(s) _____

Initial Field Data and Measurements

Depth of Well _____	Reference Used _____	
Depth to Water _____	PID/FID Reading _____	
Height of Column _____	Interface	Yes / No If yes, Depth _____ Lighter / Heavier
Well Casing Diameter _____	Material _____	General Condition
Protector _____ Road Box / Stickup _____		Casing Secure
Ground to Reference _____		Collar Intact
Comments _____		Cover Locked
		Other (describe)

Development Information

Purge Volume Factors

0.5" - 0.01

 $1'' - 0.041$

1.5" - 0.091

 $2'' - 0.16$

4" - 0.65

6" - 1.5

Initial Sample Observations

Clear

Colored

Cloudy

Turbid

Odor

Sheen

[illegible]

Development Method Peristaltic Pump / Bailer / Inertial Pump / Other _____

Field Decontamination?	Yes / No	If Yes, with what?
------------------------	----------	--------------------

Waste Container ID

Additional Comments

Field Personnel _____ Signature _____

Project: Farrel Ansonia 0000100.001		Start Date	Well ID
Client William Jayson Location LEA		End Date	
LEA Sample Identification		Logged by	
Measured depth to bottom of _____ Measured depth to water/liquid _____ Measured depth to Interface _____ Interface checked by bailer? Yes / No Separate Phase Lighter / Heavier		Date ____/____/____ Time ____:____	
Protector Material _____ Diameter _____ Length _____ Ground _____ Stickup _____ Key # _____ Cover Type _____ Condition _____ Capped? _____ Locked? _____		Concrete Diameter _____ Concrete Condition _____ Reference Stickup _____ Description _____ Casing Diameter _____ Material _____ Condition _____ Stickup _____ Capped? _____ Locked? _____ Screen Top _____ Bottom _____ Material _____ Diameter _____ Length _____ Slot Size _____	
Comments			



Signature

FIELD BORING LOG

Loureiro Engineering Associates, Inc.

BORING ID: _____

Project		0000100.001		Page _____ of _____	
Location		Farrel Ansonia		Date ____ / ____ / ____	
Client		William Jayson		GPS Latitude _____	
				GPS Longitude _____	
Drilling Method _____			Drilling Contractor _____		
Sampling Method _____			Drill Foreman _____		
Groundwater Depth _____ at _____			Drill Rig _____		

Elevation/ Depth	Sample Information					Description of Recovered Material	
	Sample Number(s)	Recovery (% or n/n)	Blows/6" / Downforce	Time	PID/FID (ppm)	Mass	(Color, primary grain size and amount, other grain size(s) and amounts, density, moisture, coherence, structure, sorting, other characteristics)

Comments

Waste Container	Trip Blank ID(s)
Field Personnel	<i>Signature</i>



Loureiro Engineering Associates, Inc.

FIELD SAMPLING RECORD WASTE CONTAINER INSPECTION

Project	0000100.001	Page	_____	of	_____
Location	Farrel Ansonia	Date	____/____/____		
Client	LEA				
	William Jayson				
Waste Container Number	_____	Container Size	_____		
Client's Number	_____	Container Opening	_____		
Container Label	_____	Container Material	_____		

	Container		Contents	
	Primary	Secondary	Primary	Secondary
Cream				
Clear				
Black				
White				
Red				
Green				
Blue				
Brown				
Pink				
Orange				
Yellow				
Grey				
Purple				
Amber				
Green-Blue				

Container Condition	
Good	
Fair	
Poor	

Contents State	
Solid	
Liquid	
Sludge	
Gas	
Trash	
Dirt	
Gel	
Other	

Full	Partial	Empty

Empty Weight _____
Full Weight _____

Started Filling on _____
Filled on _____

Screening Information

Radioactive	<input type="checkbox"/>	Water Reactive	<input type="checkbox"/>	Halide	<input type="checkbox"/>	Cyanide	<input type="checkbox"/>
Acidic	<input type="checkbox"/>	Water Soluble	<input type="checkbox"/>	Inorganic	<input type="checkbox"/>	Flammable	<input type="checkbox"/>
Caustic	<input type="checkbox"/>	PID/FID Reading	<input type="checkbox"/>	Organic	<input type="checkbox"/>	Oxidizer	<input type="checkbox"/>
Air Reactive	<input type="checkbox"/>	Combustible	<input type="checkbox"/>	Alcohol/Aldehyd	<input type="checkbox"/>	Inert/Other	<input type="checkbox"/>

Where is/was this container stored? _____

Shipped to _____ on _____

Shipped by _____

Manifest _____

Comments

Field Personnel _____ Signature _____



CHAIN OF CUSTODY

001

Loureiro Engineering Associates, Inc.

Case Number

Page of
Date / /

LEA Comm. No.	0000100.001
Project	Farrel Ansonia
Location	LEA
Project Manager	Jeffrey Loureiro
Sampling Method	
Matrix	Soil Vapor Water Other
Container Type	

	No. of Cont.	Time	Mass (gm)	PID/FID Reading	Sample Matrix	Analysis(es) Requested
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Comments	Transfer Number	Item No.	Relinquished By	Accepted By	Date	Time
	1					
	2					
	3					
	4					
Cooler ID(s)						
Field Personnel	Signature					



Loureiro Engineering Associates, Inc.

FIELD SAMPLING RECORD
PERFORMANCE SAMPLE

LEA Comm. No.	0000100.001	Page _____ of _____
Project	Farrel Ansonia	Date ____/____/____
Location	LEA, Plainville, CT	
Client	William Jayson	

LEA Sample ID	_____
LEA Sample ID	_____
LEA Sample ID	_____
LEA Sample ID	_____
LEA Sample ID	_____
LEA Sample ID	_____

Field Personnel	_____	_____	_____	_____	_____	Signature
-----------------	-------	-------	-------	-------	-------	-----------